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Official Publication of the American Association of Textile Chemists and Colorists

THE OBJECTS OF THIS ASSOCIATION ARE:

"To promote increase of knowledge of the application of dyes and chemicals in the Textile Industry.

"To encourage in any practicable ways research work on chemical processes and materials of importance to the Textile Industry.

"To establish for the members channels by which the interchange of professional knowledge among them may be increased."

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AMERICAN
DYESTUFF REPORTER

VOLUME 25 AUGUST 10, 1936 NUMBER 16

Synthetic Fibers Vs. Natural Fibers

A Consideration of Some Facts Bearing on the Future of Rayon

By F. P. W. WILSOME

IN VIEW of the present continuous expansion in the rayon industry it is well to consider two important facts in relation to a number of others with a view to ascertaining whether or not rayon is likely to replace the older fibers, cotton, wool, linen, and silk.

The first fact is that during the past thirty years the world production of rayon has increased from ten to thirty million lbs. per annum and that at the present time there is a keen struggle among the leading industrial countries to be the largest producer of the most satisfactory types of rayon. On every hand there are indications that more and more rayon is going to be manufactured.

The second fact is that in spite of the increasing production of rayon the amounts of other fibers being consumed does not diminish. Wool is in good demand at increasing prices, and cotton is reported as being consumed at a greater rate than last year. Real silk is at least holding its own.

Placing these two facts together it would seem that the introduction of rayon into the textile industry has not displaced the older fibers but rather has stimulated the demand for textile materials generally, so that more and more of both synthetic and natural fibers will be used for knitting and weaving. Some little support for this view is given by the statistics which show that of all textile fibers now being used, cotton accounts for 54 per cent, wool 15 per cent, rayon 5 per cent, and silk 1 per cent.

Undoubtedly rayon can add to the attractiveness of fabrics made with other fibers such as wool, cotton, and linen, and since, on the whole, these other fibers are cheaper than rayon it is likely that mixture fabrics containing rayon will meet with an increasing demand. It is in this manner that rayon can stimulate the demand for the older natural fibers. In this light, rayon can be considered as "monkey gland" for the textile industry.

But for how long will rayon march forward hand in hand with cotton and wool? Will there not come a time when rayon feels that she can do without the other companions and seek to be the sole textile fiber?

Our own view is that such a time will surely come. But because others have the opposite opinion it will be well to review some further facts bearing on this point.

One outstanding fact is that while rayon fibers have been steadily improved as regards their uniformity and properties, no such progress has taken place with the older fibers. All natural fibers lack uniformity since it is difficult to control the growth of cotton hairs on a seed, or wool fibers on a sheep's back. It is reasonable to anticipate that natural fibers never can be produced so that they are uniform in thickness, luster, handle, and length. On the other hand, it is possible to spin a rayon so that the individual fibers are uniform within very close limits. Moreover the important characteristics of fiber thickness, length, and cross-sectional shape can be regulated as desired, in the case of rayon. On these grounds alone there is reason to suppose that a time will come when rayon will be so improved as to be superior to the older fibers.

This fundamental difference between the positions of rayon and the older fibers, that is, the progress made with the one and the stagnation of the other, can with advantage be considered in somewhat more detail. Turning to cotton and wool one finds it difficult to point to any one fundamental property for which there has been discovered a method of improvement during the past twenty years. Efforts have been made to make cotton warmer in handle by making it wooly. In this connection will be recalled the treatment of cotton with mixtures of concentrated nitric and sulfuric acids, with acid chlorides, and with aromatic sulfochlorides followed by reaction with ammonia to introduce amino groups into the cellulose molecule. None of these treatments have been so successful as to create more than a very small degree of interest. It must be admitted, however, that non-crush cotton can now be produced by incorporating a synthetic resin within the fibers. But no method has been discovered for making cotton immune to damage by treatment with acid and oxidizing agents, and it is so far quite impossible to make

cotton stronger except by mercerization as discovered 80 years ago.

In the case of wool, even less improvements have been effected in its fundamental properties. Lately, improved methods have been discovered for rendering wool unshrinkable in washing, but in this case the benefit can only be partly used since many finishing processes for giving a superior handle and appearance to wool fabrics actually utilize this unique felting property of wool. For wool which has felted there is as yet no treatment known by which the fibers can be loosened from each other, and perhaps such a discovery of this kind would be even more important than that for making wool non-felting.

Wool is a good non-conductor of heat and in this respect is much superior to other fibers, but it is not known how to make wool better as regards this property. The scales on each wool fiber are liable to become detached by mechanical or chemical means, but there is no known method for making them resist removal to a greater extent than they do now.

Turning to silk it is interesting to note that the considerable difficulty experienced in manufacturing perfectly level dyed silk hose has been traced to the presence in the same hose of thick and thin silk fibers. How impossible it is to control the silk worm to avoid this fault!

The more detailed does this examination of natural fibers become the more evident it is that we have scarcely any control over producing them to assist spinners, knitters, and weavers. Past records show that natural fibers are just as irregular as ever they were.

Now let us consider what improvements have been made in the case of rayon. It is not difficult to show that within a few years striking improvements have been made and these have all had the effect of stimulating the use of rayon.

Firstly there is the important property of tensile strength, not only in the dry state but also when wet, for it is a well known disadvantage of all rayons that they temporarily lose strength when wetted. The following data has been given a short while ago by A. B. Shearer and H. Hegan of Courtaulds.

The dry tenacity of the old Chardonnet rayon (nitrocellulose process) was 1.1 grams per denier and the extensibility was 8 per cent. In 1907 viscose rayon had a dry strength of 1.1 grams per denier and extensibility of 15 per cent, but by 1935, the dry strength had risen to 2.1 grams per denier and the extensibility to 20 per cent. The corresponding improvement in wet strength is from 0.35 gram in 1907 to 1.1 grams per denier in 1935. Thus the wet strength of the average viscose rayon now in use is equal to the dry strength of the rayon used nearly thirty years ago.

As regards the future, it is known how to make viscose rayon (after the Lilienfeld process) with a dry strength of 4.8 grams per denier, and it seems certain that in the future it will be discovered how to put this process or a similar one into large scale use. Since real silk has a tensile strength of about 5 grams per denier it is quite evident that rayon will soon be its equal as regards this particular property.

Softness of handle and quality of luster are two further important properties of rayon which must play a part in its competition with real silk and other fibers. Softness of handle can be controlled in two main ways. Firstly, the composition of the spinning bath and the degree of stretch applied to the rayon threads at the time of spinning have an important effect. Secondly, the fineness (denier) of the individual rayon fibers affects softness: the lower the denier the softer is the rayon. Both of these properties have in recent years been so favorably modified that the best types of viscose rayon are only slightly inferior to real silk. Acetate rayon compares even more favorably than viscose rayon in this property of softness and luster.

Within recent years luster control has largely passed out of the hands of the fabric dyer and finisher, for rayon manufacturers now produce low luster rayon yarns made by incorporating titanium dioxide in the spinning solution so that the resulting fibers contain white opaque particles which gives them the desired matt or half-matt appearance.

That a rayon manufacturer should be able to produce a fiber which is strong, soft, and suitably lustrous is important, but it is even more important that these qualities should be regularly maintained. It is perhaps along these lines that manufacturers have made most progress in recent years. Dyers and finishers who are most concerned with uniformity have recognized that the rayon of today is much better than that of five years ago. In particular, the dyeing properties of rayon are now maintained very uniform so that there is no longer a constant complaint from dyers that knitted and woven rayon goods becomes "barry" during dyeing as a direct result of unequal dyeing properties.

Putting all these facts together it seems that rayon must be regarded as a fiber whose properties are steadily being improved and are such that they can be maintained uniform within close limits, whereas natural fibers do not lend themselves to improvement and are naturally non-uniform as a result of conditions of growth. There is thus the possibility that rayon manufacturers will in the future be able to produce a rayon which has the properties desired by textile manufacturers and then will be the time for the decline to set in as regards the use of the older fibers. It is believed that this state of affairs will actually come to pass—perhaps sooner than present conditions would just now indicate.

ANNUAL MEETING
AND CONVENTION
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December 4th and 5th

Recent Research on Cellulose Fibers–III

(Concluded from July 27th issue)

The X-Ray Method—Effects of Non-Crystalline Cellulose—Strength of Cellulose—Crystallinity and Textile Properties

ONE purpose of these short reviews of advanced research on cellulose may be stated again. While presenting some of the newer points of view, they are intended to caution the reader against too ready acceptance of new ideas and to assist in the evaluation of research papers and published abstracts.

The method of study of cellulose by the X-ray diffraction diagram provided a brand new outlook and a fresh start in the study of this complicated material. We are on the way to knowing cellulose much more intimately than ever before although in this field, too, there is not yet agreement on many of the details.

The principles of the X-ray methods have been covered in the AMERICAN DYESTUFF REPORTER at various times. Their application can be illustrated by the acetylation of ramie.

First, ramie is one of the best examples of a fiber with a pronounced crystalline nature; its characteristic X-ray diffraction diagram is widely regarded as evidence of the presence of micelles or submicroscopic crystals. Second, if a chemical reagent causes a fiber to show a new or changed diffraction diagram it indicates that the fiber has undergone a chemical change. If there is no change in chemical composition there may be an internal molecular rearrangement[1].

If, on the other hand, there has been no change in the X-ray diagram it is not safe to conclude that there has not been a chemical reaction. There may be an extensive reaction on the micellar surfaces but the layers of reaction product may still not be thick enough to yield its characteristic diagram.

Acetyl cellulose has a very different diagram from native ramie but if ramie is acetylated up to 38.7 per cent of acetic acid, which is equivalent to 50 per cent of the cellulose, there is no evidence of the new diagram. Beyond this point, if acetylation is continued, the X-ray diagram of the product appears to an increasing extent while that of the cellulose is found to decrease.

The explanation is that the reaction takes place on the micellar surfaces and that about half the volume of the crystalline micellar cellulose is in them. If the fiber is reasonably well purified the reagent acts first at all of these surfaces; then it proceeds inward and the product of the reaction only yields its X-ray diffraction diagram when more than one molecular layer has been formed.

The micelles are so exceedingly small that one cubic centimeter of fiber mass has six square meters of internal crystal surface. Hence 50 per cent of the crystallized cellulose can lie in the outer molecular layer. If it were merely a question of the superficial fiber surface, there should be a response to the X-rays at 6 per cent transformation.

There is not complete agreement yet that the presence of crystallites or micelles has been proved or that they are necessary to explain the phenomena of cellulose and its reactions. However, it can be seen from the foregoing example that this hypothesis seems, at times, to fit very well into the picture.

The mordanting and dyeing of cotton are not chemical reactions but take place at the surfaces of the crystalline cellulose both inside and outside of the fiber. The internal micellar surface is so much greater than that which comes to the outside that we think of the active surface available for dyeing as internal. Such purely surface effects do not cause distinctive X-ray diffraction diagrams even though the surface affected is distributed all through the cellulose substance.

In other words the X-rays do not give evidence of the formation of compounds or of systematic arrangement or orientation of such surface deposits as dyes and mordants. There has, however, been evidence from other sources that there is orientation of dyes at cellulose fiber surfaces.

In contrast, the more extensive swelling reactions, such as that with concentrated caustic alkalies, proceed beyond the crystallite surfaces and as soon as there is sufficient penetration new X-ray diagrams may be obtained.

The permeability or penetration of different materials into cellulose fibers becomes a new study if the membrane systems can be proved to actually extend throughout the fiber walls as outlined in the second article of this series. According to these views there are not homogeneous fiber walls for which the theories of permeability and swelling were developed.

EFFECTS OF NON-CRYSTALLINE CELLULOSE

Schramek[2] believes that he has explained the reactions of aqueous solutions of alkalies upon cellulose fibers without the need of any membranes of foreign material.

The idea of a regular cellulose structure according to the micellar theory has changed to that of micelles or crystallites which are not packed together like bricks but may have unoriented chain molecules of cellulose between them. This picture gives a better explanation of many of the chemical and physical processes in the treating of cotton. The proportion of unoriented thread-like molecules of cellulose in cotton and in other cellulose fibers is between 20 and 40 per cent leaving, on the average, about 70 per cent of crystalline cellulose.

Considering the whole fiber for a moment, it is composed of layers and the latter, in turn, from fine fibrillae. There may be intermediate "striae." Incidentally, when the layers in the cotton fiber cell wall break down to long fibrils these fibrils are not cut by cross membranes.

Farr[3] and Eckerson, in important fundamental studies on cotton, have described the fibrils (not fibers) as composed of small particles pressed together in single rows. Each particle is surrounded by a layer which is pectinous in nature. These particles are not the micellae which are much smaller, nor are the layers surrounding them the membranes already discussed. This is too much of a departure from the results of all earlier research to have been acceptable to all students of cellulose, but the work seems to have been carried out most carefully.

STRENGTH OF CELLULOSE

From all of this it is evident that the cellulose fiber is a structure which must contain some, at least, of the various sorts of discontinuity attributed to it. Its strength-giving elements must extend through or around the discontinuities and strength may be limited by them. Three factors are responsible for the strength of single fibers:

(1) The length of the cellulose molecule.
(2) The attachment or interholding of free molecule ends or micelle ends.
(3) Forces on the micelle surfaces.

These must act in some way through or across any such discontinuities as membranes.

Within the cellulose itself there is the amorphous or non-crystalline cellulose which acts as a cementing material between the crystallites. In normal native cellulose these cementing molecules are relatively densely packed and can be regarded as united almost in the form of the crystal lattice with the crystalline micelles. From the sharply defined layers in the fiber it would seem that the matting together of the fine long molecules into a solid union takes place only within each individual layer.

Luedtke's[4] views on strength of cellulose are colored by the results of his researches on the fiber membrane system. In the first place it limits the lengths of cellulose chain molecules. As evidence, the membrane of a native fiber can be cut across at any position at any angle and the cut surface will not respond to the zinc-chloride-iodine test thus showing that cellulose does not extend through it. The micelle chains are too short to determine fiber strength, being not over a few tenths mu in length. Hence, according to him, the exceedingly great strength of fibers is explained by the membrane system rather than by the cellulose micelles.

We have thought for years of the system as a whole, as the cause of the great fiber strength. Luedtke concedes that the atomic and micellar forces which can be effective between cellulose and cell membranes, as well as within the cellulose, are also important.

CRYSTALLINITY AND TEXTILE PROPERTIES

Some of the chemical derivatives of cellulose fibers can be crystallized in the ordinary way, for example, trimethylcellulose. The X-ray diffraction diagrams show the same characteristics for the substance itself as when in the fibrous form after transformation and before recrystallizing, except that they do not show the orientation features of the fiber.

Obviously the dissolved and recrystallized derivatives do not have the physical properties of fiber for spinning. The X-ray diagrams do not, therefore, indicate complete identity, which leads to the conclusion that the fiber properties are not due to the crystalline fiber components which yield the X-ray diagram but to fiber elements which are not registered in this way. These are the inter-crystal materials and membrane systems (Hess).

The phenomena of swelling and solution will also show that the crystalline cellulose has relatively little to do with the textile-chemical properties. Taking the action of swelling agents there are two states of swelling. First is that of compound formation where the change of volume is but slight, and which corresponds to the entrance of the reagent into the lattice of cellulose or its derivatives. Second is that in which the fiber in contact with the swelling agent takes on plastic-elastic properties. There follows a large amount of shrinkage and an increase of cross sectional area, even up to 1800 per cent. The fiber may continue on into solution.

The second state is supposedly due to the solubility of the compound formed in the first. Here the system of membranes comes into play. It can be shown that the outer skin of the fiber has a semipermeable character. It allows the swelling agent to pass in but does not allow the dissolved compound, formed between it and the cellulose, to pass out.

This is considered not a question of the cuticle of the fiber but of another layer on the outside. Each fiber is a unit osmotic cell which will take up as much liquid as the strength of the cell allows. Actually, however, it is more of a system of cells which are similar although not identical. The skin has elastic properties and can stretch but breaks if its strength is exceeded. Then the liquid contents of the fiber streams out into the surrounding solution.

As evidence of the liquid colloidal state within the fiber, Brownian movement can be detected under the dark

field microscope. As a specific example, cotton is first converted by 17 per cent caustic soda to soda-cellulose I; the fibers then swollen with cuprammonium solution; and at just the right stage the motion can be seen. In other outwardly intact fibers, particles could be seen streaming along the fiber direction as allowed by the destruction of the cross membranes. Others have burst and the contents flowed out.

It is clear from such observations (Hess) that the cellulose fiber in the second stage of swelling is no longer a solid but an elastic tube filled with a colloidal liquid. Hence the plastic-elastic properties of the fiber.

It is not correct to attribute the fiber strength to the crystalline cellulose (Hess). The material between the crystallites, or the system of membranes within the fiber determines the mechanical properties. The strength can be diminished very greatly without losing the crystallite form if the outer layer or membranes are destroyed. The formation of oxycellulose, or hydrocellulose, in the first stages of attack of the fiber is certainly to be regarded as damage to the membrane system. These modified celluloses are still identical in crystal form with the original fiber cellulose crystallites, but the strength is impaired or nearly gone. (Numerous arguments can be raised against these conclusions and much more evidence would seem to be necessary for their acceptance.)

It is hoped that these brief reviews have served their intended purpose of presenting points of view, rather than trying to state final results, or even final opinions in this rapidly developing field. The research workers who have been quoted are no doubt continuing their work and, as is frequently the case, may find it necessary to revise their present views. Eventually the final correct explanations will be a harmonious whole. Meanwhile, for research purposes and as a matter of general interest we have tried to show how the knowledge of the structure and properties of cellulose fibers is being extended.

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[1]K. Hess, Textilberichte *15*, 29 and 65 (1934).
[2]Schramek, Monat. Textil Ind. *49*, 241, 257 and 289; *50*, 13 (1934 and 1935).
[3]Wanda K. Farr, Paper Trade Journal, Sept. 26, 1935.
[4]Luedtke, Zellstoff and Papier *15*, 273 and 320.

(Conclusion)

Dyehouse Costs*

Cost Reduction Through Economical Use of Dyeing and Finishing Materials

By J. P. REDSTON†

THE economical use of dyeing and finishing materials means simply getting the desired result with the minimum outlay of money or using processes in which the money value of our materials works at its maximum. In short, we are aiming at 100 per cent efficiency. And this is only to be obtained by continuous application to every detail that makes up a dyeing or finishing job.

LABORATORY CONTROL OF NEW PRODUCTS

Before we can use materials we have to purchase them. Behind purchasing for a dyeing plant should be the idea that we are buying, and that we are not being sold to.

There are so many auxiliary dyeing and finishing products on the market and so many similar types of dyestuff that it is almost impossible to accept a product for use in one's own plant by hearsay. It should be an infallible rule of every dyehouse, no matter how small, to test the new product in the laboratory or dye kitchen before being put into use. For the testing of strength of dyestuff and for the making of sample dyeings the equipment required is certainly not very elaborate; all that is required is an electric hot plate and a few enamel saucepans and a few breakers and measuring cylinders and pipettes.

The grain or gram scale used for weighing the dyestuff for the dyehouse is certainly accurate enough as the dyestuff can be made up for example 1 grain in 1 litre or vatin so that each cubic centimeter is equivalent to only 0.001 of gram. The total equipment for a small dyehouse laboratory costs under $25.00 and the investment will pay for itself many times over.

LABORATORY ASSISTANCE IN MATCHING COLORS

Most dyehouses overlook the service that a laboratory can render on color matching. The prevalent idea is that the dyer has to match the shade anyway. No doubt he does match the shade. But often if left to his own devices he is not positive before he starts a lot what dyestuffs are required to give an exact match, exact match meaning one that looks the same as the sample in all lights. Whereas if the shade was matched in the laboratory exactly beforehand little trouble would be experienced in the dyehouse, and the lot would be dyed very much quicker,

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†Belding-Corticelli, Limited, Vice-President, Canadian Association of Textile Chemists and Colourists.

saving not only labor and dyestuff but also the condition of the material.

Too often lots are dyed near to shade before it is found that the cast of the shade is not right or that it doesn't match in artificial light and that means the color must be stripped off and a lot of unnecessary processes gone through.

This laboratory assistance is what every dyer should have. It doesn't cost much money because a serious young man with normal vision can become, under direction, a fair color matcher in nine months or so, especially if he has a lot of colors to match and is allowed to struggle through and do the matching himself. The work is fascinating and being creative captures the enthusiasm of anyone connected with it in a practical way.

In dyehouses where all colors are predetermined the cost of labor and of material shows savings of 25-50 and even more per cent. Of course the appearance of dyed goods is considerably enhanced. By saying that all dyeings should be predetermined in the laboratory I do not mean to disparage the skill of the dyer.

ADVANTAGES OF FORMULA DYEING AND FINISHING

Over a period of years a good dyer can match any shade with an average of something like four shots of dyestuff, without a formula as a guide. This is really remarkable when one considers all the ramifications of dyeing and the high demands made today for color matching. But the fact still remains that with the aid of a formula a big improvement could be made and those lots that get out of control and go off shade would be eliminated.

It is these re-dye lots or lots that take a long time to get on shade that make the difference between a dye-house that is operated efficiently and one that is not. Perhaps I might say here that formula dyeing must be approached with a sympathetic scientific attitude. Because if a formula is made out for say 100 lbs. in 400 gallons of water it is hopeless to expect to get the identical result by dyeing 50 lbs. in 400 gallons. The liquor in the machine should be if possible let down to 200 gallons.

Of course dyeings in the laboratory are made on the same material and under as near as possible identical conditions as in the dyehouse, that is, the ratio of liquor to goods and temperature, etc., are kept the same.

The same idea is applied to finishing. Too often large quantities of goods are put through long finishing processes only to find that the hand or feel of the goods is not right when the whole thing could have been predetermined by treating sample pieces. In the case of pieces on which new finish needs to be applied the liquid finish can be applied on a sample quetsch and the necessary mechanical treatment given by sewing the sample piece on the end of a standard lot going through.

One trouble about the laboratory work is that sometimes the same percentage of dyestuffs dyes darker in the dyehouse than in the laboratory. This can be overcome by using dyestuffs which exhaust as of course dyestuffs which exhaust are often the most economical to use, but they cannot always be used, and where colors do not exhaust in the laboratory a little less percentage is used in the dyehouse. Where dyestuffs which exhaust are used it is not necessary to pay such great attention to volume.

A LIBRARY OF COLOR SHADES ESSENTIAL

Every dyehouse should keep an efficient formula system, and even when lots do not come out on shade a sample and a formula should be kept against future requirements for such a shade.

Good formulae mean quicker dyeing, more even dyeing and cheaper dyeing and are of immense value to any dyehouse because every dyehouse gets repeat orders. Indeed a good formula system should be kept in a safe against all hazards; it means the customers' repeat orders will always be the same shade, and the formula will be worth thousands of dollars to a firm. Once an extensive library of shades and formulae has been built up laboratory dyeings are no longer required, but it needs 6,000 to 7,000 to make a good library.

EXPERIMENTS AND RESEARCH IN THE LABORATORY

A laboratory is not only useful for shade matching; it can often teach in a few experiments what might take years of experience to learn and experience generally means trouble. For example, in dyeing by any continuous process or on the jigger or by any dyeing process it is important that dyestuffs are used which exhaust at the same rate; this can be determined by time dyeings in a laboratory, that is by putting say 10 pieces of materials into say the three colors being tested and pulling one out after each minute of dyeing and then mounting these dyeings to compare the speed of exhaustion.

There are a great number of textile auxiliaries on the market, indeed we think that textile auxiliaries are one of the seven wonders of the new world because each one is said to be suitable for every individual textile process from making direct colors as fast as vat colors down to making wool shoddy feel like silk. No doubt there are some specific properties that one product has more fully than the other, and simple laboratory tests can often be devised to differentiate between samples.

If a wetting-out agent is required solution of auxiliaries can be made up and pieces of the material to be wetted out can be dropped on to see which one wets out and sinks first.

If the agent has to stand hard water the effect of hard water can be noticed by adding hard water and calcium salt solution to a solution of the agent in distilled water.

If it has to stand an acid or an alkali, that can be in turn introduced.

TESTING TO ASSURE ECONOMY IN PURCHASING

A book might be written on testing dyeing and finishing ingredients. It can become very fascinating to find out just what kind of stuff is being offered for sale on the

(Continued on page 440)

PROCEEDINGS OF THE
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AUGUST 10, 1936

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Lowell Textile Institute Student Section
Herbert A. Wormwood, Chairman; Henry S. Anthony, Secretary

North Carolina State College Student Section
A. E. Shumate, Chairman; J. W. Furr, Secretary

Members should notify the **Secretary** immediately of all address changes

ANNUAL OUTING, NEW YORK SECTION

THE annual outing and golf tournament of the New York Section was held on Friday, June 26, 1936, at the North Jersey Country Club, Pompton Road, Paterson, N. J. During the day golf, tennis and horseshoe pitching absorbed most of the attention of the members and guests.

In the evening an excellent dinner was served after which followed distribution of the many prizes. There were prizes for low gross and low net for members, low gross for guests, kickers, tennis, horseshoe pitching, etc. There follows a list of those who were awarded certain prizes for proficiency in golf: low gross for members—to Milton Harris, 82; second low gross for members—tie between P. J. Kennedy and Lucian, 93; low net for members—J. D. Huizeng, 69; low gross for guests—J. Devigne, 80. Werner von Bergen was the champion horseshoe pitcher and H. P. Baumann won the tennis tournament.

It was an ideal day for the outing and the attendance of approximately 90 enjoyed the opportunity to renew old friendships under such happy surroundings. The committee on arrangements for the outing had provided everything desired for the entertainment of those who attended.

Respectfully submitted,

P. J. KENNEDY, *Secretary.*

Calendar of Coming Events

Third Annual Joint Outing, Piedmont, South Central and Southeastern Sections, Signal Mountain Hotel, near Chattanooga, Tenn., August 14th and 15th.

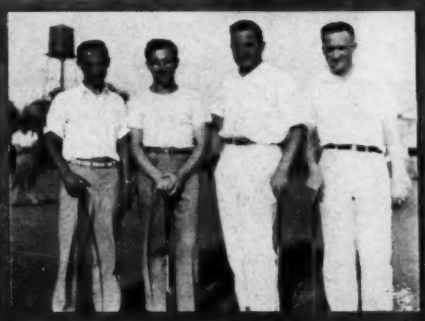
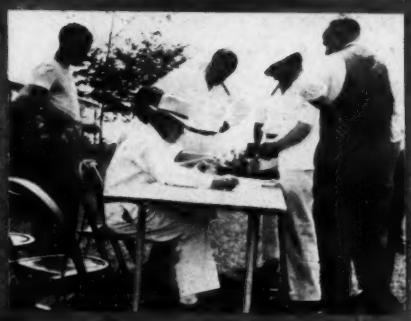
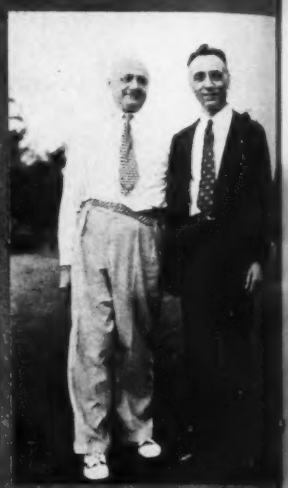
* * *

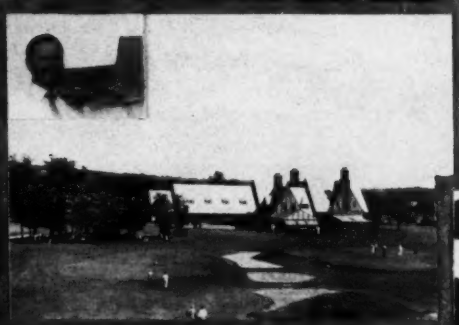
Annual Meeting, Providence, R. I., December 4th and 5th.

Annual Outing
New York Section
June 26, 1936

North Jersey
Country Club
Paterson, N. J.

Photographs
by John J.
Sokolinski



Technical Emulsions*

By KARL T. STEIK†

I WILL have to start out with an apology. I was in hopes that we would be able to have a movie that would show the preparation of emulsions and also the behavior of emulsions when they are applied in the industry, but typical of emulsions, they behaved in such a manner that made the completion of our program impossible for the present. Therefore, only a small part will be shown of what we really expect to finish some time, perhaps before long. This will only show the sort of nonchalant way in which technical emulsions have to be prepared in order that the users of such emulsions will bother with them at all.

So if you will now have patience, we will have a short movie showing how emulsions are made, and in this particular instance it will be a preparation of an emulsion which in the beginning stage will be a water in oil emulsion and then change to an oil in water emulsion. If you watch closely, you probably will notice the change of the color. The change of the color in the movie will not be quite as characteristic as in the actual emulsion.

. . . A motion picture was thrown on the screen at this point, during the course of which Dr. Steik made explanatory remarks. . . .

By way of getting an orientation point, I should like to ask you a question, and that is, Why are emulsions like executives? One familiar with executives and emulsions should be able to answer the question. If you don't know what an executive is, I might give you Hubbard's definition: Executives are people who sit at a desk, warm their swivel chair and make decisions which sometimes are correct. (Laughter.) If there is hesitation now to see the connection between executives and emulsions, well, emulsions sometimes are also correct. (Laughter.)

That applies only to emulsions that are talked about. It doesn't apply to technical emulsions. Technical emulsions must be correct or they wouldn't be used, just like an employee other than an executive must be right or he will lose his job. (Laughter.)

When two liquids are mixed, the following may happen: As a result, you may have one liquid, and that will be the case when the two liquids are miscible in each other—the result will be a solution. If the two liquids are not completely miscible, or not miscible in the proportions as they are used, then a part of one liquid may dissolve in the other liquid, and the other part that does not dissolve may be dispersed. The degree of dispersion or the particle size of this non-dissolved liquid or non-dissolved portion may vary very much. So that there is a gradual transition from molecular dispersion (that is, the solution) to very coarse emulsions, suspensions where the particle sizes are even, let us say, visible to the eye, individual particles.

If you start out with two pure liquids—and assume they are not soluble in each other—you do get after, say, a thorough mixing, an emulsion, and that liquid which is broken down into the particles is called the dispersed phase. The other liquid in which these particles are dispersed or suspended is called the continuous phase. When only two liquids are used, and the dispersed liquid is some pure compound like a hydrocarbon, such emulsions are as a rule very dilute. The amount of the dispersed phase may be one, two, three parts in ten thousand.

If the concentration goes beyond that, increases, then instead of being almost opalescent you may get even a milky appearance. But such emulsions, consisting only of the two phases—the dispersed and the continuous phases—as a rule are very unstable. For that reason, and because they can be prepared only in very dilute concentrations—although claims have been made that such two phase emulsions have been made concentrated to the extent of two per cent, but the instability is still there—two phase emulsions have very little practical application. At times they become annoying. For example, if you get lubricating oil dispersed in water, although the amount of the oil is not very great, still it might be very undesirable.

What happens when such dispersion takes place? When an electric current is passed through such a two phase emulsion, then the dispersed particles migrate to the positive pole. That would indicate that the particles carried a negative charge. Then the question arises: Where did the charge originate?

When it comes to explanations for what I am going to mention now and also for anything subsequent, I want you to keep in mind that "stand pat" explanations in reference to emulsions are very rare. Exceptions can always be taken because, as we will see later, conclusions have been drawn on the basis of some one factor in the emulsion. Generally, more than one factor is involved with the degree of dispersion of the emulsion and also with the stability, which somewhat goes along with the degree of dispersion.

One theory is that the source of the negative charge of the dispersed particles is the OH ion from water. We know water is somewhat ionized and that these particles

*Presented at meeting, New York Section, February 28, 1936.
†Director of Research, National Oil Products Co.

adsorb the hydroxyl ion, and that gives the particle the negative charge. Since the positive and negative charge particles in a system are equivalent, having the OH ion adsorbed, the hydrogen ion must increase relatively. Therefore, such a water should become acidic. There is no indicator, apparently, that would show such small hydrogen ion concentration. In order that the hydrogen ion concentration would come within the range of an indicator where some indicator would show color, an indicator that has color in an acid solution, it is necessary, first, to sort of boost up the hydrogen ion concentration by a dilute hydrochloric acid.

Deutsch some years ago performed an experiment where he used 1.6 over a thousand normal hydrochloric acid, and used thymol sulfo-phthalein as indicator, which at that concentration does not have its reddish purple color, but at a little higher concentration shows color. If such a solution of hydrochloric acid is shaken with benzol, then the acid color appears. When that emulsion breaks, and the adsorbed hydroxyl ions on the particles let loose, the color of the indicator disappears again.

So there is some sort of experimental proof that the hydrogen ions or hydroxyl ions come from the water.

For such two phase emulsions the stability depends practically entirely on the particle size, and Lewis by experimentation, obtaining such emulsions by various means, reached the conclusion that the particle size for such emulsions, in order that they be stable, is of the order of one ten-thousandth of a millimeter. By complicated mathematics Donnan came to about the same conclusion, simply by calculation.

So, experimental evidence and calculated figures coming to close agreement, there is some reason to conclude that one ten-thousandth of a millimeter is about the particle size required for stable emulsions of this type.

The phenomenon—you no doubt are all familiar with the term—of why the particles migrate when an electric current is passed through is known as cataphoresis.

Now I shall go over to the type of emulsions which are of industrial importance and those are what you might call the three phase emulsions. When I talk about emulsions, unless otherwise stated I mean oil as the dispersed phase and water as the continuous phase. So in order that such emulsions be stable, they have to be three phase emulsions. That is, a third phase must be introduced and the functions of this third phase are to stabilize the emulsion.

The third phase, the emulsifiers or emulsion stabilizers that have been used in the past and that are used at present belong to quite a number of groups of compounds. The oldest and still very effective emulsifiers are the soaps of fatty acids, water soluble soaps of ammonia, potash and sodium of fatty acids having twelve or more carbon atoms per molecule.

Then perhaps next in order would come the so-called sulfonated oils, sulfonated castor oil, sulfonated olive oil, neat's-foot oil, cod liver oil, herring oil, and any kind of unsaturated oil, or an oil which in the acid radical contains a hydroxyl group. Those are the types of oils that have been sulfonated. By the word "sulfonated" is not meant true sulfonation, that is, there is no sulfonic group formed, sulfur to carbon bond, but a sulfate. So these sulfonated oils are only sulfuric esters, $CO\text{-}SO_3H$. And then we have our emulsifiers where fats have been condensed with aromatic nuceli, true sulfonic acids, aromatic; also sulfonic acids, salts or soaps obtained in the sulfuric acid refining of petroleum distillates.

To this group that might be called fatty emulsifiers also might be added the rather recent emulsifiers, esters, sulfuric esters of higher alcohols, alcohols corresponding to fatty acids, the soluble soaps of which are emulsifiers; alcohols with C_{12} and up, C_{14}, C_{16}, C_{18}.

These alcohol esters—or they may also be sulfonic acids—all have properties of soaps.

Generally, sperm oil and wool grease are passed along as oils or fats, although they are waxes, and on saturation they also can be converted into sulfuric acid esters.

Then come the true waxes, like beeswax, or carnauba wax, which also may be used as emulsifiers.

Then there are the emulsifiers which contain nitrogen, a protein nitrogen. There you have casein, gelatin, haemoglobin, egg yolk, egg white, pepsin, and albumin, and in this group you might also include lecithins although they are not proteins, but they contain nitrogen.

Then you have what might be called the carbohydrate group of emulsifiers, gums, gum arabic, tragacanth, pectin, agar-agar and some others. To this group perhaps we have to add the dried plant, technically known as the Irish moss. There, too, the carbohydrate is the principal emulsifier, although it contains somewhere around seven per cent of protein matter, which no doubt adds to the emulsification also.

Then you have a substance like lamp black, which predominantly forms water in oil emulsion. I don't know where to classify that. It contains carbon and organic acids.

In the inorganic group the main emulsifiers are the fine clays, all kinds of basic salts, basic sulfates of copper, zinc, nickel and elemental sulfur.

For the opposite type of emulsions, for water in oil emulsions are used the alkali earth soaps, soaps of calcium, magnesium predominantly, and also, sometimes, of zinc and nickel.

There are several factors that influence the stability of an emulsion. In order that an emulsion may break like the emulsion here has broken (it is not important enough to pass these bottles around, but you can see that there is distinctly a layer which in time will be clear oil and that happens quite frequently) naturally, there is a rise of one liquid through another one, the rate at which the oil will rise through the continuous phase will depend on the dif-

ference in the specific gravity. It will also depend on the viscosity of the continuous phase and on the particle size.

The relationship is expressed by

$$\text{Stoke's equation } v = \frac{.2\, r^2.\ (s\text{-}s^1).\ g.}{9\, n}$$

where v = velocity with which the particle rises,
r = radius of the particle,
$s\text{-}s^1$ = difference in spec. gravities of the two liquids,
g = gravitation constant,
n = viscosity of the continuous phase.

So you see how important the viscosity is there. If the viscosity is very great, the velocity becomes less and sometimes where it is permissible that fact is taken into consideration. Use is made of it. If you don't want the oil to rise so quickly through what is practically water there, you can increase its viscosity by incorporating some gum. Then, naturally, the particles will have to edge up with greater difficulty, and the rate of separation to the extent where a layer of oil formed on top, what is technically called creaming, will be naturally retarded.

In the three phase emulsions the dispersed particles carry an electric charge and when a current is passed through, cataphoresis occurs. Between the dispersed phase and the continuous phase there is a difference of potential. It seems that the greater the difference of that potential, the greater is the stability of the emulsion. That difference of potential is around sixhundredths of a volt. When that is the difference, then such emulsions are fairly stable.

When the difference of potential becomes zero, then the emulsion breaks and that point is called the iso-electric point. However, Powis found that breaking begins somewhat before the iso-electric point is reached, and he calls that point the critical potential.

In the case of the three phase emulsions, the addition of electrolytes has a great effect on the stability of these emulsions. It is interesting to note the effect of the valence of the positive ion of the electrolytes. Having a series of salts where the negative ion is the same, there is no relationship between the valence of the positive ion and the effectiveness with which such electrolytes work to cause separation of an emulsion. For example, in the case of potassium chloride, it takes 5000 millimolls per liter to reach the critical potential difference. In the case of barium chloride it takes ninety-five millimolls. In the case of aluminum chloride it takes .51 and in the case of thorium or titanium, it takes only about .01 millimoll per liter.

The figures 5000, 91, .51 and .1 are in no relationship to the valence of potassium, barium or aluminum or titanium or thorium.

There is some speculation as to why there is the difference. I say "speculation" purposely because we now come again to explanation, why something happens, why the electrolytes work as they do. The explanation as given is that the difference—mind you now the oil in this emulsion is negatively charged so that is why the positive ion has the effect apparently by way of neutralization of the negative charge—in the action is supposed to be because these various positive ions are not adsorbed by the dispersed particles to the same degree, and I suppose these figures, 5000, 95, .51 and .01, would then represent the degree to which these different positive ions are adsorbed.

The surface tension of the oils themselves with which we have to deal in technical emulsions does not vary considerably. Expressed in grams per square centimeter, olive oil, for example, runs 0.0337; sesame oil, 0.0324; linseed oil, 0.0333; castor oil is somewhat higher, 0.037. The temperature doesn't have a very great effect on the surface tension. For example, if the dynamic interfacial tension is measured by Donnan's pipette at thirty-five and fifty degrees, for peanut oil at corresponding degrees it is sixty-six and sixty-four and a half—a very small decrease at the higher temperature; cotton seed, sixty-five at thirty-five, and sixty-three at fifty degrees; soy-bean oil, sixty-eight and sixty-nine.

Neat's-foot oil: I have figures here at three different temperatures: at twenty degrees, forty-eighth—this, mind you, represents Donnan drops—at forty degrees, forty-eight drops, so that there is no difference between twenty and forty; and at sixty, forty-four, only a slight reduction.

Depending upon the state of aggregation of phases which are in contact with each other, the interfaces may be immobile or mobile. We are concerned with contact of liquid phases, therefore, also with liquid interfaces.

From the point of view of molecular theory of matter, a drop of a liquid chemical compound consists of a great number of molecules. Within a certain radius exists a mutual attraction between an individual molecule and its surrounding molecules. Within the body of a liquid the resultant of inter-molecular attractive forces is zero because each individual molecule is surrounded by a group of similar molecules. On the surface of a drop or a body of a liquid a state of stress exists because the attraction inward is greater to the extent that the number of molecules in the upper half of the sphere of attraction is less. Because of the greater attraction inward, there is a tendency toward reduction of the surface and, therefore, drops of a liquid suspended in a immiscible fluid, or a gas, contract to a minimum by assuming a spherical form. The force acting on the surface of a drop of liquid suspended in a gas is called surface tension, on drop of a liquid suspended in a non-miscible liquid—interfacial tension. The total surface tension, known as surface energy, is expressed in dynes per centimeter times the total area.

Laplace assumed the cause of surface tension to be due to molecular attraction. Inside of a liquid the mutual attraction between the molecules is neutralized, while on the surface a part of the force remains free and is directed

inward and, therefore, tends to diminish the area of the surface.

According to later theories the so-called residual valences are involved. In the formation of complex compounds, as those of Cr and Co, residual valences come in play. Certain organic groups, such as CO, COOH, —CH=CH are involved in the formation of molecular complexes through their residual valences. Organic liquids may have closely alike surface tension, but have greatly different interfacial tensions (water), particularly those which contain active groups. The active groups orientate themselves toward water and by their residual valences may attract ions or dissolved substances, as a result of which the sum of residual valences is decreased, so is the surface tension toward water also decreased.

From thermodynamic consideration it is evident that all substances which are capable of reducing the interfacial tension accumulate at the interfaces. As already mentioned, according to theories of Langmuir and Harkins, a substance possessing many unsaturated residual valences, has high interfacial tension. But when such a liquid comes in contact with another liquid containing in solution substances capable to saturate the residual valences, then there is an attraction and retention of these substances at the interface. When the residual valences are partially saturated, the surface tension decreases, the particles of the suspended liquid become more subdivided, the result of which is an increase of interfacial surface.

The surface tension of a liquid is quite readily determined with a surface tension balance, for instance. The determination of the interfacial tension, particularly of the final interfacial tension is quite difficult, or even impossible. When in a three phase emulsion, the emulsifier diffuses to the interface, that diffusion naturally takes a certain amount of time. It may be rapid or slow. At present we have no means for determining the final interfacial tension.

With the Donnan's pipette, for instance, are determined the number of drops per a given volume delivered from a tube and tip of definite dimensions. By this means is determined the so-called dynamic interfacial tension, while the emulsifier is still moving to the interface. This gives an indication as to what the emulsifying powers of an emulsifier might be, but does not give an answer as to possible stability of the emulsion. The stability of the emulsion depends on the final interfacial tension, known as static interfacial tension.

Additions of certain compounds to the oil may influence their oil/water interfacial tension considerably, as can be shown by the greatly increased number of drops from a Donnan pipette. In the case of rapeseed oil, a saponifiable oil, small additions of caustic soda will greatly increase the number of drops as shown by figures in Table I.

It is not the added caustic soda that reduced the interfacial tension of rapeseed oil. If in place of a saponifiable

TABLE I

NaOH Mol/Lit.	*Number of Drops*
0	88
0.0005	115
0.0008	213
0.001	306
0.0011	430
0.0013	continuous stream

oil a highly refined mineral is used in an experiment as above, only a slight reduction of interfacial tension will be observed; 47 drops for mineral oil, 52 drops after addition of NaOH. This slight reduction is because it is very difficult to obtain a mineral oil that is absolutely free from any saponifiable matter. If stearic acid alone is added to a purified mineral oil, there is only a very slight reduction of interfacial tension. But if to a mineral oil containing stearic acid caustic soda is added, the interfacial tension is then greatly reduced, from 48 to 320 in terms of Donnan drops. That shows quite plainly that the soap, which is produced by the addition of caustic soda, is responsible for the reduction of interfacial tension.

The extent to which soaps reduce interfacial tension depends, among other factors, on the size of the molecule of fatty acid. When starting out with mineral oil and testing the change of its interfacial tension because of addition of fatty acids with gradually increasing number of C-atoms in their moleules, and when the same equivalent quantity of caustic soda is added, then the changes of interfacial tension of oil will be approximately as follows:

formic acid—slight reduction
acetic acid—no effect
butyric acid—slight increase
caprylic acid—slight reduction

In the case of lauric acid, 12 C-atoms per molecule, the reduction of interfacial tension is considerable, from 43 to 82 drops (Donnan). With stearic acid, under the same conditions, no drops are formed, but the oil runs in a continuous stream.

Soaps or salts of fatty acids with less than 12 C-atoms per molecule behave very much like electrolytes even in fairly concentrated solutions. Soaps of acids with higher number of C-Atoms do not behave like electrolytes even in very dilute solutions. Such solutions have abnormal elevation of boiling point, depression of freezing point, conductivity, etc. Such solutions are not molecular, but colloidal.

When the number of C-atoms in the molecule of fatty acids is greater than 18, the reduction of interfacial tension decreases with the increase of molecular weight. Besides the molecular weight, the position of the carboxyl group in the molecule also has an effect. In natural fatty acids the carboxyl group is at the end of the molecule. In

the synthetic acids prepared by Roger Adams he noticed that the reduction of interfacial tension was increased as the carboxyl group was moved nearer the middle of the chain. Substances that act as emulsifiers and reduce the interfacial tension contain a hydrophylic group. This group has attraction for water and to a degree is responsible for the solubility of the substance in water. Such hydrophylic groups are the COOH, COONa, CSO_3H, $C\text{-}OSO_3H$, NH_2, etc. These groups possess residual valences and how these are responsible for reduction of interfacial tension, was already mentioned.

By introducing the hydrophylic group $C\text{-}OSO_3H$ or $C\text{-}OSO_3Na$ into a molecule of a fat, good emulsifying agents are produced. This is possible with unsaturated or hydroxylated oils and fats by treating them with concentrated sulfuric acid under certain conditions. The acid adds at the double bond or reacts with the OH group, like in an esterification reaction. In either case are produced acid esters of sulfuric acid with the fatty molecule. Since the acid esters are not very stable but hydrolize readily, they are neutralized with a base that is suitable in any particular case. Usually only a part of the oil or fat is so "sulfonated" and it serves to emulsify the unchanged oil. The higher the degree of "sulfonation", the greater the degree of dispersion of the emulsion of such oil with water.

Since a film of the emulsifier around the dispersed particle of oil is required to keep it from coalescing with similar particles and to keep the emulsion from breaking, the greater degree of dispersion of certain amount of oil will require greater quantities of the emulsifier, because with the degree of dispersion increases the surface area of the dispersed phase. A coarse emulsion may be quite stable but may become unstable when the degree of dispersion is increased by such means as passing the emulsion thru a colloid. Normally a more stable emulsion would be formed because of the decrease of dispersed particle size. But if there is insufficiency of the emulsifier to take care of the increased dispersed surface, the emulsion will break and clear oil will separate out on top.

After standing for a day or more, the layer of clear oil will remain constant. By analysis of the emulsion for oil and emulsifier and by determining the particle size, information may be obtained what the ratio of oil and emulsifier must be in order to obtain a stable emulsion of that degree of dispersion. Of course here it is understood that the emulsions are fairly concentrated. Very dilute emulsions, as mentioned before, may be stable in absence of an emulsifier if the degree of dispersion is very great.

In the textile industry, use of emulsions is made in the scouring operation. Before the fibers are passed through various mechanical operations, some oil is applied to them in order to increase their elasticity. Before dyeing, this oil has to be removed by scouring. Scouring does not offer much difficulty when the oil is a saponifiable oil, but if the oil were mineral oil, and particularly when applied on wool, then a complete removal of it is impossible by ordinary scouring. This may be so even if the oil, before being applied to the wool, could be readily emulsified with the scouring agent and water.

The difficulty in scouring is because of the adhesion of the oil to the fiber or to the fabric. The structure of the fabric is of importance in determining the ease of oil removal. Also, within any one homologous series of compounds, whether they be hydrocarbons, acids, etc., the adhesion increases as a linear function of the molecular weight. If, at the same time, the molecule has polar character, then the adhesion is still greater, i.e., for the same molecular weight adhesion is greater with an acid than with a hydrocarbon.

The reduction of oil/water interfacial tension as a rule helps scouring. A good compound for that purpose would be one which is effective in reducing the interfacial tension but which itself does not adhere to the fiber to be scoured. Oleic acid is quite effective in reducing the high mineral oil/water interfacial tension; mixtures of mineral oil and oleic acid are not easily removed from wool by emulsification. When 5 per cent by weight of oil is applied to wool fabric, optimum removal is when the oil contains 80 per cent of oleic acid, residual oil being 0.18 per cent by weight of wool, while when straight oleic acid is used the residual oil is 0.38 per cent, according to Speakman and Chamberlain. Apparently, when scouring is started by emulsification, the oleic acid is saponified, and as soap removed to the water phase. From that point on, mineral oil is scoured by soap without a polar compound being in the oil. A study of the distribution of the scouring agents between the wool/oil and oil/water interfaces may point out a way for finding a proper scouring agent.

The newer scouring agents which do not contain the COONa group have the advantage of being neutral in aqueous solutions, which is desirable for wool and silk, but recent investigations show that the optimum pH for scouring is at 9.5. In hard water, however, the new detergents have an advantage over soap, unless some sodium metaphosphate is used along with the soap.

I have here a few samples of emulsions of various degrees of dispersion. Here there are no particles visible under the microscope with 1100 magnification, and it looks like a solution. As the oil particle size increases, the emulsions become more milky in appearance, as you see. This emulsion (showing sample) is of the type that requires intermittent agitation. It has been stirred for a short period when it was prepared in the afternoon, and now the oil and water have separated into layers. When shaken up again, the emulsion will last for several days without the slightest separation. The emulsifier in this case, sodium oleate, diffuses slowly to the mineral oil/water interface and, therefore, some particles coalesced

and formed a layer. Further, it is the acid soap that is adsorbed at the interface and the formation of this soap by hydrolysis of the original neutral soap that also requires time.

In connection with what you saw on the film, at first a water in oil emulsion is formed which, on further addition of water, changes into an oil in water emulsion. The change of one type of emulsion into another takes place quite frequently in the course of preparation of industrial emulsions, particularly when some components are solid. When the change to oil in water emulsion has taken place, then the emulsion can be further diluted with water to any desirable extent. Concentrated emulsions sometimes are very unstable because with a certain amount of water neither type of emulsion is stable, resulting in separation of layers.

It is generally assumed that soaps made with a base having more than one valence form the water in oil type of emulsion. Here is an example of emulsion where a lead soap is the emulsifier, and yet the emulsion is of the oil in water type. The soap in this case is of a rather unusual composition.

Because of the late start, I had to modify the talk I had originally planned. Perhaps some points that should have been mentioned will be taken up in the ensuing discussion. Therefore, I will stop at this point.

DISCUSSION

Chairman Freedman: We have just listened to a very interesting lecture on technical emulsions, and I don't doubt but that there are many questions that you would like to ask Dr. Steik. Without further ado, I will throw the meeting open for such questions. Dr. Harold, will you lead off the discussion?

Dr. Harold: I presume that you were referring to straight chain monocarboxylic acids in connection with the effects of the position of the carboxyl group on reduction of interfacial tension. Then, as the carboxyl is moved more towards the center, the molecule becomes more nearly symmetrical.

Dr. Steik: Yes. Starting out, for example, with a straight chain fatty acid with 18 C-atoms, at the ends there is a CH_3 group and a carboxyl, and CH_2 groups in between them. As the carboxyl group is placed nearer the middle of the molecule, i.e., the 9th C-atoms from either end, not counting the carboxyl carbon itself, there will be a gradual increase of reduction of interfacial tension. The maximum decrease will be if the carboxyl is located on the 9th carbon atom in the C_{17}radical.

Dr. Harold: Yes, but if the molecule contained a sulfate group and a carboxyl also—

Dr. Steik: Then the case would be like with oleic acid, a molecule with two polar groups. The double bond is polar. Then the polar groups would tend to orientate themselves towards water, and the result would be that the molecule would become bent, touching the water at two points. Such a molecule would reduce the interfacial tension more than a molecule with only one polar group.

Dr. Harold: You also said, did you not, Doctor, that the addition of electrolytes stabilized emulsions?

Dr. Steik: To a certain extent, small additions of an electrolyte stabilize by increasing the degree of ionization of water. Beyond this amount, the positive ions of the electrolyte are absorbed by the particles carrying the OH ion, as a result of which the charge on the particle is neutralized. When that happens, there is no repellent force on dispersed particles; they coalesce. Such particles, coalesced, are too big to be kept in suspension by molecular forces. The particles rise to the surface, producing either creaming or a clear layer of oil.

Dr. Harold: I should like to ask if in the case of wool there is any hope of getting rid of that mineral oil if one were to use a saponifier at the isoelectric point of wool. Would there be a better chance of getting rid of that 2 per cent of residual oil in that way?

Dr. Steik: I do not know of any experiments to answer that point. Some of the new detergents of non-soap character would be stable at the iso-electric point of wool. The complexity arises because of the existence of two interfaces; wool and oil, and oil and water. From the point of view of eliminating chemical changes in wool caused by the emulsifier, working at the iso-electric point would be very desirable.

Mr. Schmidt: I might say, in this connection, that we have made extensive experiments, and have perfected a product that is however not yet ready for the market. We took wool and dipped it in a wool oil emulsion, probably one part of oil and two to three parts of water, and used olive oil, lard oil and ordinary wool oils. With this special oil, with a new polar compound, and scouring in the laboratory, we only had one-tenth of one per cent of oil left on the wool.

Dr. Steik: That is very good, if the process is practical. Apparently soap is not involved for it itself is left on wool to the extent of about 0.35 per cent.

Dr. Powers: I wonder if you have been able to measure satisfactorily liquid-liquid interface.

Dr. Steik: Only the dynamic liquid-liquid interfacial tension, not the final interfacial tension.

Dr. Powers: That is air/oil interface that you are actually measuring?

Dr. Steik: Yes, the air/oil interfacial tension with a surface tension balance, or the oil/water dynamic interfacial tension with the Donnan pipette.

Dr. Powers: But your air-liquid tension gives an indication?

Dr. Steik: Yes, to the extent whether a liquid is going

to be hard or easy to emulsify. Since the surface tension of oil differs comparatively little, there is not great help. In the case of mineral oils, the surface tension is high, so is the oil/water interfacial tension.

Mr. Guiterman: When a solid is dispersed in a liquid, is the solid going to have a negative charge?

Dr. Steik: That would depend on the solid and also the liquid that forms the continuous phase.

Mr. Holden: Does one type of emulsion have any advantage over the other in textile processing? I have in mind the ability of one to withhold the water better than the other. That is, will the oil in water remain less readily than the water in oil? Which will give up its water more readily?

Dr. Steik: The oil in water emulsion will give up its water more readily, on evaporation, for instance. By way of comparison, I would say that the water from milk evaporates more readily than water that is in butter. A surface lubricated with a water in oil emulsion will appear more greasy, and such an emulsion is less likely to penetrate to give inter-fiber lubrication. If the surface only is lubricated, the cloth, or leather, will be stiff on bending and have little elasticity.

Mr. Holden: I have in mind rope, twine, and the sort of things which are quite different from wool and cotton.

Dr. Steik: I don't know, but I imagine that in the case of rope it would be desirable to decrease the friction between fibers.

Mr. Holden: That is true in the finished product, but whether it is true in the processing operation is rather difficult to state.

Dr. Harold: Have you any product in your company that is a good spot-proofer as well as water-proofer for high pile material? I mean, has that been licked? Can we hope for a water in oil emulsion, or an oil in water emulsion, for that type of treatment? I do not want you to make this a sales talk, but I just want to know if you or any other scientist has a good spot-proofer that could be used as a rain spot-proofer.

Dr. Steik: We have three products that are used for such purposes as you mentioned. NOPCO A. T. O. is being used quite successfully as a spot-proofer and water-repellent for high pile fabric. This is a wax product, and it is applied as an emulsion. After drying, the wax on the fibers does not re-emulsify very readily and, therefore, it stands washing fairly well. It does not stand dry cleaning because the dry cleaning fluids dissolve out the wax.

Then we have two other products, Metasap No. 567 and Metasap No. 569. Both products are concentrated solutions of aluminum stearate, containing about 30 per cent of solids. The use of metallic soaps for waterproofing is well known. Their application has been rather difficult because even dilute solutions are very viscous. Now it is possible to prepare concentrated solutions which are perfectly clear and almost as mobile as water. These concentrated solutions can be diluted with almost any solvent, such as toluol, varsol, ethyl, acetate, chlorinated hydrocarbons, etc. These may be brushed or sprayed on, or the material may be dipped. After drying, the film left behind is colorless, waterproof and non-tacky. The film of Metasap No. 569 is more flexible than that of Metasap No. 567. These products are particularly well adapted for re-waterproofing after dry cleaning.

Dr. Harold: It is possible to get something that is water-tight, yet it will spot in rain.

Dr. Steik: That is apt to happen when the water-proofer is deposited on the cloth along with the emulsifier. When rain drops strike such a cloth reemulsification takes place in spots, and on drying rings are formed. This is not likely to happen when no emulsification is possible, as in the case of the application of aluminum stearate from an organic solvent.

Dr. Harold: Couldn't you obtain the same result by using ammonia soaps as emulsifiers and subsequently drive off the ammonia?

Dr. Steik: I doubt whether it would be safe to heat any cloth to a sufficiently high temperature to decompose the ammonia soaps leaving the free fatty acids behind. Besides, free fatty acids oxidize quite readily and also affect the tensile strength of the fibers.

Dr. Harold: We hear that maleic anhydride and things of that sort will prevent rancidity and bad secondry effects. Have you had any experience that would justify that claim?

Dr. Steik: You are referring now to anti-oxidants. Anti-oxidants as a rule only increase the inhibition period. After the inhibition period is over, oxidation proceeds as if no inhibitor were present. Some antioxidants are quite effective with neutral glyceride oils, but not so with free fatty acids. With the oils with which we have to deal the experience in our laboratory has been that maleic acid is not an effective oxidation retarder.

Chairman Freedman: Are there any further questions?

Dr. Harold: I move you, Mr. Chairman, that a rising vote of thanks be extended to the speaker of the evening.

Chairman Freedman: A motion has been made that a rising vote of thanks be extended to the speaker of the evening for his most entertaining and constructive lecture. Is it seconded?

. . . The motion was duly seconded, put to a vote and unanimously carried. . . .

. . . The meeting thereupon adjourned at ten forty-five o'clock. . . .

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the secretary any vacancies which may occur in their businesses.—H. C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive.

NOTE: PERSONS WHO HAVE OBTAINED EMPLOYMENT SHOULD NOTIFY THE SECRETARY OR THE AMERICAN DYESTUFF REPORTER AT ONCE. Prospective employers may file vacancies either with the secretary or the American Dyestuff Reporter.

A-6

Education—Analytical Chemistry and Dyeing Course, Lowell Textile Evening School.

Experience—Seven years as print color and dye chemist in printing, dyeing and finishing plants; recently in charge of textile printing department of dyestuff manufacturer.

A-B-2

Education—Lowell Evening Textile School, 1917.

Experience—Five years' experience in hosiery dyeing, full fashioned hosiery of silk and cotton and silk, also men's hosiery containing rayon, wool, cotton and celanese. Several years experience in laboratory work. Has also had experience in jig-dyeing of cotton piece goods, slub and top dyeing.

A-B-4

Education—B.T.C. 1934, Lowell Textile Institute.

Experience—Assistant chemist in cotton knitting plant; second-hand in woolen knit goods dye house. Will go anywhere; references.

A-B-5

Education—Graduate of the University of Lausanne, Switzerland. Doctor's degree in Chemistry. Knowledge of French and German.

Experience—Eleven years with large bleaching, dyeing, printing and finishing plant as assistant Chemist and then Chemist in charge of the Laboratory. Experience in dyeing and printing cotton and rayon fabrics; research and analytical work. Woman.

A-B-7

Education—Evening school in textile dyeing.

Experience—2 years laboratory in dyehouse; 9 years dyer and foreman on hosiery, ribbons and rayon; 2 years assistant to superintendent. Can handle help efficiently. Desires position as supervisor or demonstrator of dyestuffs. Age 30; married. Prefers vicinity of New York.

A-B-C-2

Education—Graduate of Lewis Institute of Engineering of Chicago and graduate of Philadelphia Textile School (Chemistry and Dyeing department).

Experience—Has had extensive experience as assistant chemist and colorist in silk printing, dyeing and finishing; also dyeing raw stock wool; and dyeing and finishing cotton and rayon. Age 30; married; references.

A-B-C-3

Education—3 years at Brown University and Drexel Institute.

Experience—2½ years in dyestuff laboratory; 3 years as second-hand, dyeing indanthrene and direct colors on rayon skeins; 6 months as boss dyer on silk and cotton ribbons and hosiery; 3 years overseer of dyeing and finishing rayon tubing. Can handle laboratory, dyehouse, finishing or outside service. Age 30; married.

A-B-C-D-E-1

Education—B.S. Chemistry, Mass. Institute of Technology.

Experience—Plant and laboratory work. Knowledge of wool scouring; cotton, worsted, celanese and rayon slashing; bleaching, dyeing, printing and finishing of cotton cloth; printing of Plissé; manufacture of soaps, finishing compounds and wetting-out agents; analytical work; solution of mill manufacturing difficulties; dyestuffs and their application to wool, cotton, rayon; textile teaching experience; paper mill work; some sales experience; references; married; 43 years old.

A-B-C-F-1

Education — Five years chemistry and engineering, Brown University (Evenings).

Experience—1 year general superintendent at print works (shirtings, dress goods, etc.; cotton and rayon). 12 years chief chemist and superintendent of large bleachery and dyeworks (cotton, rayon and silk piece goods). 4 years chemist in charge of control work in bleach, print and dye works (cotton, wool and rayon piece goods). 9 years chief chemist and assistant superintendent in gas and oil manufacture. Practical dyer and finisher and can handle help efficiently and get results. Can help a plant seeking to improve their vat dyeing, shrinkage results, finishes and service to customers. Age 45; married.

A-C-1

Education—4 years at Newark Evening Technical School in Chemical Engineering.

Experience—8 years in manufacturing, research, testing of soaps, oils, gums and finishes and application of same in all phases of the textile industry. Age 23, single. References.

A-E-1

Education—Ph.D., Univ. of Illinois, studied chemical engineering at Columbia, licensed chemical engineer, New Jersey.

Experience—10 years' experience teaching in colleges, subjects included chemical and textile subjects. Has had broad experience in industrial work including experience in testing materials, research and consulting. Will go anywhere; references.

B-1

Education—Educated and trained in chemistry and calico printing in Glasgow, Scotland.

Experience—Has been with large print works as colorist for 13 years producing first class work on cotton, rayon, wool and silk fabrics. References.

B-2

Experience—Boss dyer with one firm for 18 years, divisional supt. at print works for 1 year, in charge of processing and dyeing of cottons and rayons at large bleachery for 6 years. Prefers bleachery in East but will go anywhere. References.

B-3

Experience—Foreman piece dyer for the past 21 years. Can dye the following: celanese, rayon, cotton backs, wool, silk and mixed fabrics. Has knowledge of finishing and laboratory work.

B-6

Education—Graduate R. I. School of Design.

Experience—5 years in bleachery, 7½ years as assistant dyer, 2 years as boss dyer and 3 years as superintendent of dyeing and finishing. Married, 33 years old. References.

B-7

Experience—Eight years as boss dyer on skeins and ribbons. Over ten years as chemist and head dyer for a large hosiery mill. Experienced on Silk, cotton, rayon and wool in skeins, ribbons, piece goods and all kinds of mixtures. Willing to go anywhere. Not afraid to work or face responsibility. Can handle help efficiently.

B-8

Education—Chemistry and Dyeing Department, Philadelphia Textile School.

Experience—Eleven years experience as chemist and boss dyer on the following: woolen, worsted and cotton yarn; woolen, worsted and union piece dyes on both ladies' and men's wear; wool, cotton, shoddy and mohair raw stock. Age 33, married, will go anywhere. References.

B-9

Experience—Hosiery dyer with fifteen years' experience on high grade silk hosiery; familiar with all types of machines. Age 43, married. Will go anywhere.

B-14

Education—Rhode Island School of Design.

Experience—Familiar with all classes of wool dyeing. Seven years with large carpet mill as dyer and processor of washed oriental rugs. Will go anywhere, married, 37 years old. References.

B-15

Education—B.T.C., Lowell Textile Institute, 1934.

Experience—Experience in dye house running washers, dye kettles and as a dye weighter.

B-17

Education—Lowell Textile Institute (Chemistry and Dyeing Course) 1916; extension courses at Brown University.

Experience—6 months dyeing wool at finishing company; 2½ years research work on bleaching, dyeing and finishing at dye works; inspector of textile equipment, U. S. Ordnance Dept., during war; 15 years as superintendent of dyeing at finishing company, including all types of colors on cotton piece goods and some rayon and celanese; handled chemical work at last named plant for many years as well as dyeing. Age 40, married, prefers East. References.

OUTING, NORTHERN NEW ENGLAND SECTION

THE annual outing of the Northern New England Section was held at the Nashua Country Club, Nashua, N. H., on Friday, June 12, 1936. Edward Weber, as chairman of the Outing Committee, arranged one of the largest and most successful outings in the history of the Section. Although the weather appeared quite hopeless on the morning of June 12, it cleared sufficiently so that about 150 members and guests were present at the dinner. On account of wet grounds, the usual tennis matches had to be eliminated, but a great many entered the golf tournament and quoit pitching contest. The Section is much indebted to the many dyestuff and chemical concerns who contributed prizes for the various sports.

Respectfully submitted,

JOHN N. DALTON,
Secretary.

Above — Edward Weber, Chairman, Outing Committee. Below — Roland Derby, Chairman, N.N.E. Section.

Below — E. C. Bertolet, Vice-President, A.A.T.C.C.

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TEXTILE DRYING RESEARCH

AT the conference on textile drying sponsored by the United States Institute for Textile Research, Inc. and held in New York City on May 6th, several formal papers discussing the drying of textile fibers were presented which were followed by an open discussion participated in by many of the 150 representatives who were present. It was the consensus of opinion at this conference that the U. S. Institute should sponsor a research project covering the subject of textile drying. The only thing needed to put this project under way was sufficient co-operative financing to carry on the needed work. In this regard the response has not been all that is desired. Commenting upon this subject in the August issue of *Textile Research,* publication of the U. S. Institute for Textile Research, the editor says:

"It has been estimated that a substantial start can be made in securing the scientifically accurate information that is lacking if $5,000 can be made available to U. S. Institute, preferably in individual subscriptions of $100 each. This is the cooperative basis on which U. S. Institute's warp sizing study was financed after the Textile Foundation had subscribed half of the $10,000 required. For $5,000 the largest and best equipped textile mill could expect to make little progress in a research on drying problems. U. S. Institute can, because for $5,000 it can secure personnel, equipment, materials and co-operation that would cost any individual mill five times that sum as a minimum estimate. This is confirmed by experience in the warp sizing study.

"Up to July 1 subscriptions to this drying research fund were disappointing, particularly in view of the fact that the 150 textile men who attended the conference in May were unanimous in asking U. S. Institute to undertake the financing of the study. Less than 30 per cent of the fund had been promised as of July 1. The response from the drying machinery builders, with only three co-operators, and from the control instrument firms with none, was difficult to understand. Wool and rayon manufacturers had shown the most substantial interest. There is no logical reason for any one class of textile manufacturers to feel that they are immune from drying troubles. They are all in the same kind of an unseaworthy boat, and the co-operative research offered by U. S. Institute is the cheapest and most certain method of securing the facts that will carry them to a safe harbor".

As was very clearly brought out at the May conference there can remain no doubt as to the need of a research project covering the subject of textile drying in view of the present lack of scientific information regarding the best drying conditions for the different textile fibers. The value of the research project to textile manufacturers was summed up quite neatly in one of the statements heard during the discussion: "I venture to say, although there are no figures to support this, that if the money that is spent by all of us in claims on goods that have been damaged by excessive drying could be applied to ideal drying equipment and drying methods perhaps that would solve the profit and loss element in this thing." If the conditions were known under which drying could be carried on, not only most economically, but also most safely and which would produce the desired effect on the quality of the goods then there would be no need for a research project on the drying of textiles but as this knowledge is lacking or incomplete there is a definite need for the proposed research.

This project represents an opportunity for the textile manufacturers, the drying machine and control instrument manufacturers, to contribute to a work that will be of benefit to all and a work that no single manufacturer could carry on alone except under conditions that would prove many more times as expensive. It is an opportunity that no one who has drying problems (and who hasn't?) can afford to pass up. It is to be hoped that the amount of money necessary to finance this research will be forthcoming shortly.

ANNUAL MEETING

WITHIN a short time there will appear on the pages of the proceedings of the American Association of Textile Chemists and Colorists various items concerning the preparations that are being made for the Annual Meeting of this association to be held in Providence, R. I. on December 4th and 5th, under the auspices of the R. I. Section. Information will appear concerning the technical program as well as arrangements for social entertainment. We urge you to read these items as they appear and convince yourselves that your attendance at the meeting will become a reality.

Dyehouse Costs

(Continued from page 426)

Canadian market and what a wide divergence there is in prices of some dyestuffs. It can become a fascinating hobby to get the lowest priced ingredients, because they are all different in price and in strength. The savings made by judicious buying are phenomenal. Indeed the dyestuff business is just like any other business, there is always someone willing to sell for less, and every shipment must be tested, when buying is keen, in case Glauber salt should have been introduced to take care of the offered cut in price. At any rate one can help the suppliers catch mistakes made in the mixing room.

There is always some satisfaction in feeling that one is paying the least possible price for material bought.

In connection with buying one might say that all companies selling ingredients to the dyeing trade go to a lot of trouble and expense, bring out new dyestuffs and new finishing materials and these new offerings cost money to introduce and no reliable firm will introduce new lines unless in the light of their often extensive experience they are sure that there is a market for them, and a good salesman is a technician who has a different outlook on any problem put up to him; if he doesn't solve our problem at least he often starts us on a new train of thought. Salesmen are always up to the minute on their firms' new offerings, and we can learn a lot from a few minutes conversation with a salesman because the world has been always wishing for some new thing. These salesmen always bring us something new.

SYSTEMATIC STUDY OF TRADE MAGAZINES ESSENTIAL

One cannot read too much about our industry; it covers so much ground and one's own pet job always dovetails or connects with some other branch of the dyeing industry. For example, a dyer dyeing effect threads with vat colors must understand something about hosiery dyeing and dyeing and finishing woolen piece goods if he is to dye his yarns fast to every process that the woolen pieces are to go through such as crabbing, fulling, potting, carbonizing, etc.

And in the same way the hosiery dyer should know something of vat dyeing if he is to strip his re-dyes intelligently. Even if he never dyed a vat dye, if he read the trade journals he would know that vats are dyed in an alkaline hydrosulfite bath and that to strip them he must use an acid reducing liquor or the picot edge stripe will stain the stockings. Knowledge means saving money and no one can be an expert in every line but a good general knowledge can be acquired by the full use of technical journals.

ADVANTAGES OF COLOR MATCHING MACHINES

We have read a lot in the trade journals about color matching machines. Like anything else they are regarded with a certain amount of skepticism. Too often in the textile industry we have to wait until someone sells us something. We don't go out and buy it. At least fifty companies in the United States are using color matching machines. But like laboratory control in the dyehouse they won't do everything, but like a laboratory they are a very efficient tool in the hands of the dyer. They can discern differences in color not possible with the trained human eye.

ASCERTAINING TRUE COSTS OF PRODUCTION

It is asking too much of any man to expect him to stand in the middle of a dyehouse or finishing plant and think at once of every method by which money can be saved by the economical use of dyeing, finishing material. But the whole picture of what it is costing to run the department can be brought into force by providing the dyer with a statistician. The word might sound expensive to some of you but an office girl or young man can be hired for $10.00 to $15.00 a week to do this work or in a small dyehouse it may be done as part time work by an office employee. Every single process should be costed. It is only by having the figures in black and white in front of us that we are able to see the money running down the sewer.

According to Bradstreet's eighty per cent of business tailures in the United States and Canada are due to incompetence of some description and ignorance of the true cost of production is one of the greatest of these incompetencies. A cost finding system should not only show the cost of producing something; it should show cost in such a form that the reasons for the losses are apparent.

For example one might find that it was costing say 3 cents a pound to apply a finish and on analyzing the situation we might find that the material cost was high because the finish bath didn't exhaust. In some cases finish can be applied in the "whizzer" and the excess liquid saved for use again. Profits will not amass themselves simply because a cost finding system has been installed, because what really determines price is the economic principle of supply and demand.

I am sure we all get surprises when we find out how much it's costing us for operations that we dismiss as being trivial. One might mention rinsing or washing after dyeing. This is especially serious in large plants

using a million or more gallons of water where soap is used as a dyeing auxiliary and it has to be washed out for fear that it will turn yellow or go rancid if left on the goods. Simply thousands of gallons of water go down the sewer. Most of it can be saved if the layout of the dyehouse is such that all the white and light colored dyeing machines are grouped together so that the dye liquors and wash waters can be saved in a pit and used for the dye liquors or wash waters of the darker shades. However in this case if a fatty alcohol was used for dyeing instead of soap the pieces could be rolled up and whizzed after the first rinse.

REDUCING SALT, STEAM AND DYESTUFF CONSUMPTION

A great lot of black is still dyed with direct colors and the amount of salt used runs into a lot of money in a year. This salt dye liquor can be saved and used again. A lot of money is spent on steam in a year; according to instructions for dyeing vat colors it is said to be essential to give goods a boiling soap to develop the shade, for some shades like browns this long boiling soap isn't entirely necessary and where it can be dispensed with saving in steam is realized.

A well dyed sulfur black can be oxidized artificially with chrome and a boiling soap has no effect on it so far as increasing the fastness is concerned. In place of boiling soap a cheap softener can be applied cold to offset the hardening effect of the chrome. There are many ways in which steam can be saved. Viscose pieces and even skeins are dyed at the boil when they can be dyed quite satisfactorily at 180 degrees; the drop in temperature of 20 degrees makes a colossal difference in steam demands. The only way to judge the value of the savings in steam is to install a steam meter in the department steam line before and after changes are made.

Soap boil-off baths should always be run into a pit or pumped into tanks and when sufficient has gathered sulfuric acid can be introduced and the fatty acids saponified again.

AVOIDING LOSSES RESULTING FROM UNEMPLOYED LABOR

Finishing and dyeing materials can only be applied economically if a minimum amount of labor is used. Indeed labor is perhaps more important than ingredients used. No doubt everyone should work but we are not here tonight in the role of economists. I have worked in half a dozen dyehouses and I have yet to see the dyehouse where men didn't have spells when they stood around waiting for something. In some places this is almost a necessary evil as in the case of printing machines attendants waiting while a strike is being made. Or employees waiting half an hour for a vat dye feed up to be vatted. However, the fact remains that in every dyehouse this is an awful lot of stand-by time. It is not apparent at first, but if one times the actual time that each man is gainfully employed one would be amazed at unproductive time this would amount to at the end of a month.

STATISTICAL RECORDS REVEAL HIGH COST PROCESSES

A statistician would be very helpful here. One of the reasons for this condition is faulty management. Every dyehouse carries a certain fixed overhead and the minute that the dyehouse starts to operate, the overhead jumps up by leaps and bounds, and it is only by working at capacity that this overhead can be earned and perhaps a profit realized, therefore no dyehouse should operate without having a full day's run in view. A careful costing will show that those goods which are dyed are actually costing two and sometimes three times what they should cost and the price received for them remains the same.

This is a difficult situation because some customer is always asking for delivery, but it is a situation that must be faced, and it is why by having it in black and white that one realizes the seriousness of it.

COSTING TO AVOID LOSSES DUE TO SMALL LOTS

The size of dyeing and finishing lots determines costs to a very large extent. A detailed cost system will show which units can be processed at the required price and which can not. The answer to small profits in a converting plant can often be found in the processing of small units. And the manufacturer must face the fact that small units are costing much more; sometimes a figure that seems out of all proportion to that for a standard batch.

A standard method of costing converting processes is to have some form of card system, whereby each lot is accompanied through each process by a card on which is marked down the material used in each process and the amount of labor expended on the work. An electric clock with a time punching device is very useful for marking the exact time that a lot is started and finished, as it leaves nothing to chance. Whereas if other means are employed for marking, starting and finishing times there is the possibility that they might be subsequently erased and changed. Times punched on the clock are exact; pencil marked times might not be.

The costing clerk can readily determine the detail cost but at the same time a separate account can be kept from these cards of how much material is actually used in the plant per month. By comparing these figures with the monthly pay sheets and monthly inventory one can ascertain how much labor and material one is paying for but not actually using. The discrepancy in these figures is the measure of efficiency of the department. Detailed costs of individual lots are very necessary in the case of vat colors because the cost per pound for the amount of dyestuff used can vary from 2 or 3 cents to 60 cents per pound.

Too often manufacturers are satisfied by total costs. The figure is of course very accurate, more accurate than detail costs, but it is only by detail costing that losses are apparent and the remedy suggested.

DEPARTMENTS SHOULD EARN OVERHEAD CHARGES

In many dyehouses the dyer or finisher has nothing to do with the financial standing of his department. In the dyeing department we are assessed with so much for rent and overhead and we have to show a profit. If manufacturers went to the boil-off department or dyeing or finishing department and said "You have to make your little end pay," I am sure that the interest aroused would form a big impetus to cost reduction because it would bring the whole field into critical study. It is all very well to have cost accountants and efficiency experts in a mill but the converting of textile materials offers so much scope for things going wrong and the processes themselves are really quite difficult to understand that the only successful efficiency expert or cost accountant in the plant should be the man on the job.

Competition gets keener every day and there would be a much better feeling all round if Mr. Manufacturer could feel that Mr. Finisher, Mr. Dyer were not only finishing and dyeing his goods but that they were being finished and dyed in the most economical way possible.

—♦ ♦—

Abnormal Fading of Dyes

in the Presence of Titanium Dioxide*

ALTHOUGH titanium dioxide is so inert to chemical influences it was early found that its presence in dyed rayon could cause extraordinary rapid light-fading with certain dyes, and especially when the material was wet while exposed to sunlight. For example, if a matt viscose rayon dyed with Chlorazol Sky Blue FF, while wet, be exposed to sunlight by the side of a similar dyeing on ordinary viscose rayon, it will be noticed that the matt rayon becomes nearly white within a few minutes, while the ordinary dyeing is only slightly affected. This behavior can be especially troublesome to housewives who wash their dull rayon stockings and hang them out to dry in the sunshine.

This peculiar behavior of titanium dioxide dulled rayon has been specially studied by most dye makers, but the results obtained by Messrs. Sandoz, of Basle, have been most interesting and useful. It appears that the abnormal fading is due not so much to the titanium dioxide itself as to the glycerine or similar compound present with it. Glycerine and titanium dioxide appear to form an extremely reactive mixture capable of causing the rapid fading of dyestuffs, but this effect is inappreciable with either of these substances alone. Actually the glycerine present in the rayon is introduced with the titanium dioxide paste.

The obvious moral to be drawn from these results is that finishers should not use glycerine in dulling liquors which contains titanium dioxide. It is preferable to use gums or starches for thickening purposes, and in taking this precaution they will avoid later claims for badly faded materials.

Recently it has been discovered that matt rayons subject to rapid fading in sunlight can be much improved by an after- or pre-treatment with chromium salts (E. P. 430,993). The preserving effect thus obtained may be due to destruction of any glycerine compound present or on the other hand, it may be due to the presence of chromium thus left in the dyed rayon. In treating rayon by this process, the material is immersed for about half an hour at 85 degrees C. in a 0.3 per cent solution of sodium bichromate or a 0.5 per cent solution of chromium chloride. The addition of a 0.2 per cent of formic acid may be made.

Readers interested in the application of titanium dioxide to rayon or other textile materials would do well to become familiar with the chemical and physical properties of this substance. Titanium dioxide is not a substance which has the same properties however it is prepared. It is true that practically all the titanium dioxide now being marketed is prepared from a natural mineral known as Ilmenite (extraction is effected by means of sulfuric acid followed by precipitation of the hydroxide). But this titanium hydroxide is finally heated at a high temperature to convert it into the pigment, and the properties of this largely depends on the manner in which the heating is carried out. The usual type of pigment has a refractive index of 2.7 and a density of 3.9.

The value of titanium dioxide as a delusterant is assisted by its high refractive index, and many methods have been suggested by which this can be modified. It is likely also that the association of this pigment with small amounts of other white substances such as barium sulfate and zinc oxide can result in improving it as a delusterant. In fact, there is much scope for investigation of titanium dioxide along these lines since it is obvious that if the delustering power of the substance can be improved then it will be possible to use less in the delustering liquor. In this field the finisher has many opportunities for making discoveries of considerable importance.

*Portion of an article by A. J. Hall, published in the *Textile Mercury and Argus.*

The Effect of Laundering

Upon the Appearance and Wearing Quality of Some Blanket Fabrics [1]

CHARLOTTE JACKSON with KATHERINE CRANOR [2]

Abstract

All wool blankets obtained from the same mill weighing three pounds each and measuring 72 x 84 inches were used. A length of unfinished blanket fabric was used to determine the effect of finishing upon the blanket. The blankets were weighed and measured and the new fabric analyzed physically and chemically.

The hand suction dasher and the gyrator and vacuum cup types of washing machines were used as well as the Launder-Ometer. Specimens of the fabrics were washed, rinsed and dried at temperatures varying from 85° F. to 120° F. After laundering, the specimens were examined microscopically for changes in appearance and were measured for shrinkage and thickness and tested for breaking strength. Magnified photographs were made to show changes in appearance and texture.

The breaking strength of new blanket fabric was reduced 19.6 per cent for the warp and 80.8 per cent for the filling when the fibers were pulled out from the yarns and broken. Tests show that the durability of the blanket had been sacrificed in order to obtain certain qualities considered desirable, i. e., heavy nap and heat retaining qualities. The breaking strength of the blanket fabric was not sufficiently strong to withstand wear and laundering. Blanket fabrics laundered showed less change when a small amount of friction was used in washing, rinsing and drying. High temperature alone did not cause shrinkage and felting.

The best results in laundering an all-wool blanket fabric were obtained by washing, rinsing and drying the fabric at room temperature with the washing time reduced to the minimum, i. e., three minutes. The fabric remained soft, fluffy and elastic, with even edges and little indication of shrinkage. The hand-suction dasher used at a low speed increased the efficiency of the process. The vacuum cup machine also gave good results.

INTRODUCTION

In recent years scientists and manufacturers have made many discoveries which have led to the production of blankets that meet the requirements for warmth without excess weight.[5, 11, 12]

Bed blankets should last for a number of years. It is desirable, therefore, that the blankets purchased be of the kind and quality that will give continued satisfaction to the users. With the present trend toward the making of blankets with a high, thick nap, the laundering of such blankets has become a difficult problem.[13, 14]

Research has been done on various phases of the laundering of blankets, but few results have been published which show the effect of laundry methods upon wearing quality. The following investigation is an attempt to give to the consumer some information which will aid in the selection and laundering of all-wool blankets.[3, 16, 18]

Experimental Work

The blankets used in this research were three-pound all-wool single blankets, 72 x 84 inches. A 7-inch length of the unfinished blanket fabric was used to determine the effect of finishing upon the blanket.

The blankets were weighed and measured and the new fabric analyzed physically and chemically. Then each blanket was divided warpwise into 13-inch lengths. The 13-inch lengths, after having been marked off into divisions 13 x 14 inches, by running a thread along the warp, were then laundered. A hand suction dasher and three different makes of washing machines were used for the experiment. Two of the machines were of the gyrator type and one was of vacuum cup type. One group of specimens was laundered in a commercial laundry and one group in a Launder-Ometer.

The fibers were also examined under the high power lens of a microscope. They were prepared by pulling apart and tearing out the fibers from the warp and filling yarns.

The construction of the fabric was determined by cutting away part of the nap and raveling out the filling yarns slowly, examining it under a hand-magnifying lens.

The width of the blanket was determined by spreading it out without tension on a flat surface and measuring it accurately, perpendicular to the edge. Five measurements were taken at different places on the blanket and the results averaged. The length of the finished blanket was determined by the same method.

To determine the weight of the fabric three 6 x 6 inch test specimens were used. These were brought to constant weight. The weight in ounces per square yard and

(1.) This paper is a portion of a thesis which was submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Master of Science at Iowa State College.

(2.) The authors wish to thank Professor Olive Settles of the Department of Textiles and Clothing for helpful suggestions and for additional bibliography.

the weight in ounces per linear yard were calculated and the average of the three determinations recorded.

Thickness of the fabric was determined by a micrometer. Ten measurements were taken from different parts of the fabric and the number of inches calculated.

The number of yarns per inch was counted with a Lowinson Thread Counter. The warp and filling yarns were each counted on three places of the fabric, six or more inches apart. The average number of yarns per inch was taken as the thread count.

Yarn twist and ply and the direction of twist were determined by means of the Precision Twist Counter. Ten determinations each were made from both warp and filling yarns, and the averages, divided by two, recorded as the number of twists per inch.

The length of the staple[10] was found by taking a single yarn and untwisting it to secure a bundle of parallel fibers. Single fibers were then teased out and placed against a black background where they were measured with a linear steel scale. Ten determinations each were made from both warp and filling yarns and the averages calculated.

The diameter of the fiber for both warp and filling yarns was determined by mounting a fiber from each on glass slides, under cover glasses, and examining them with the low power lens of a microscope, equipped with a calibrated eyepiece micrometer. The fibers were measured and the average diameter for each was calculated in inches.

The number of fibers per yarn for both warp and filling was determined by separating the fibers of the yarns and counting them. Five determinations were taken and the averages calculated.

The Scott Universal Tester was used to determine the tensile strength[20] and elongation of the fabric. The strip method was used. Five determinations each, of both warp and filling yarns were made and the averages calculated.

Shrinkage[2] of all laundered fabrics was determined by taking 4 measurements of the specimens before and after laundering, expressing the average in percentage change in length and in width.

1. One length of five specimens each was washed in a good suds made from a good quality of soap flakes, by hand and with the hand suction dasher and in each of the three makes of washing machines at a temperature of 100° F. for 10 minutes and rinsed one minute in two waters at 100° F.

2. Each of the lengths of five specimens was cut along the colored yarn marking the divisions, labelled, and dried as follows:

   a. Overnight at room temperature (85° F.)
   b. Four hours in the sun (95° F.)
   c. Six hours in the shade (85° F.)
   d. Four hours at freezing (30° F.—completed at room temperature)
   e. Forty minutes in a dryer (140° F.)

3. One each of the small specimens was rinsed at a temperature of 70° F. and 120° F. respectively and dried at room temperature (85° F.)

4. The third small specimen was left to run 30 minutes, then rinsed twice for one minute each at 100° F. and dried at room temperature.

5. Specimens were then washed by hand, with a hand-suction dasher, and in the three types of washing machines at a temperature of 120° F. for 10 minutes and 30 minutes respectively. They were rinsed twice by hand at a temperature of 120° F. and one of each was dried at room temperature and one at 120° F. in a dryer.

6. Later it was thought advisable to use room temperature in all laundering processes, in order to compare the home laundering test with specimens laundered in a commercial laundry by a special wool process. One specimen size 7 x 13 inches was washed by each of the five methods for one minute, soaked two minutes and the process repeated, washing them two minutes. The excess moisture was squeezed out of the specimens, they were rinsed twice at 86° F. (room temperature), and dried at the same temperature.

For the specimens of fabric laundered in the commercial laundry, a vacuum-type, 36 inch cylinder, three-rib machine was used. It was run in one direction, at a speed of 11 revolutions per minute. The machine was filled to the proper level with water at room temperature (90° F.), an olive oil base soap (free from alkali) was added, and the machine was run until a good suds was made. The 13 x 14 inch specimens were put in a mesh laundry bag and placed in the machine along with other wool garments and run 1 minute. The machine was stopped and the fabrics allowed to soak 2-3 minutes. This process was repeated twice. The machine was stopped and drained and the fabrics given two rinses. They were then treated with sterilizer which is required in all commercial laundry work. The fabrics were extracted and dried at room temperature, on drying frames. Care was taken to have no change in temperature in any of the processes.

7. Five specimens 13 x 14 inches were laundered in the Launder-Ometer by approximately the same specifications as those used for laundering woolens. The only variation was in the rinsing. In addition to the regular rinsing, the fabric was rinsed through a larger quantity of water in order to remove excess soap. The specimens were dried by the five methods previously used.

   Each specimen was examined for changes in appearance, measured for shrinkage and thickness, and breaking strength.

   Enlarged photographs were made of a few specimens showing decided change in appearance and texture as a result of laundering.

TABLE I

Analysis of the Blanket Fabric

Size of the finished blanket as given on the label—72 x 84 inches

TESTS		*Unwashed and Unfinished*	*Finished*
Fiber		All-wool	All-wool
Construction		Modified Twill	Modified Twill
Thickness of blanket in inches		0.0367	0.0398
Size of blanket in inches*	Width	80.562	71.312
	Length		82.25
Conditioned weight, oz. per	Sq. yd.	11.16	11.06
	Lin. yd	24.97	21.909
Thread count per inch	Warp.	25.	28.
	Filling	28.	30.
Twist of yarn per inch	Warp	9.9	11.7
	Filling	4.25	4.525
Yarn ply and direction of twist	Warp	Single-left	Single-left
	Filling	Single-left	Single-left
Length of fiber in inches	Warp	3.25	2.29
	Filling	3.33	2.29
Diameter of fiber in inches	Warp	0.0013	0.0014
	Filling	0.0015	0.0015
Number of fibers per yarn	Warp	80.	69.
	Filling	109.	82.
Breaking strength in lbs.	Warp.	21.4	17.2
	Filling	34.6	6.625
Shrinkage in percentage	Warp	....	.....
	Filling	....	11.4

*Only the width measurements could be taken, because a whole unwashed blanket was not purchased.

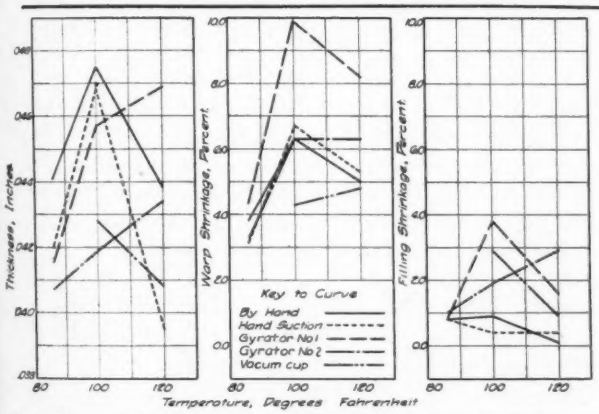


Fig. 1. Effect of Variation in Washing Temperatures upon the Thickness and Shrinkage of All-Wool Blanket Fabric. Washing Time = 10 min.

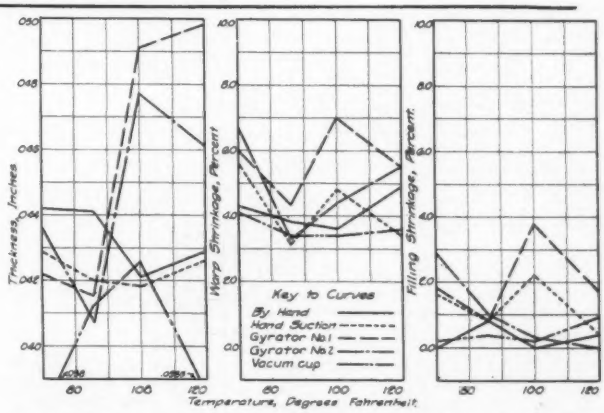


Fig. 3. Effect of variation in rinsing temperatures upon the thickness and shrinkage of all-wool blanket fabric. Rinsing time = 2 min.

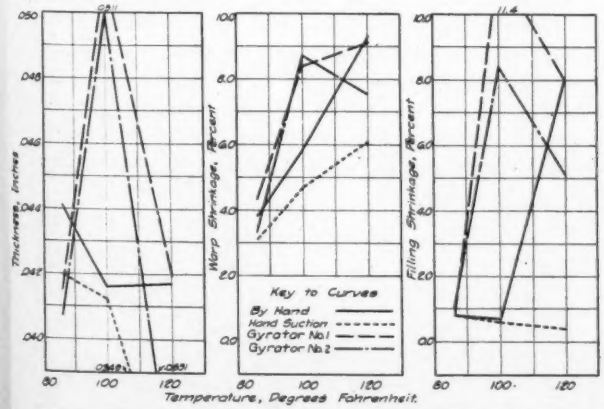


Fig. 2. Effect of variation in washing temperatures upon the thickness and shrinkage of all-wool blanket fabric. Washing time = 30 min.

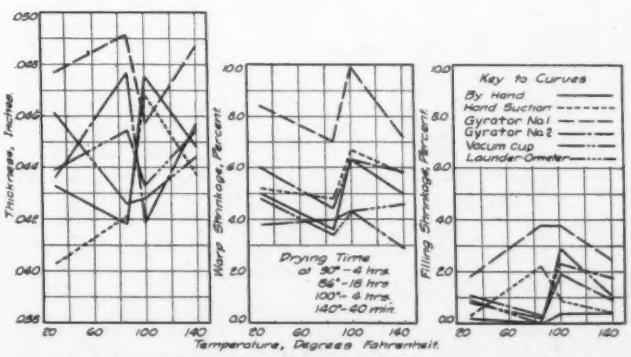


Fig. 4. Effect of variation in drying temperature upon the thickness and shrinkage of all-wool blanket fabric, after laundering by different methods.

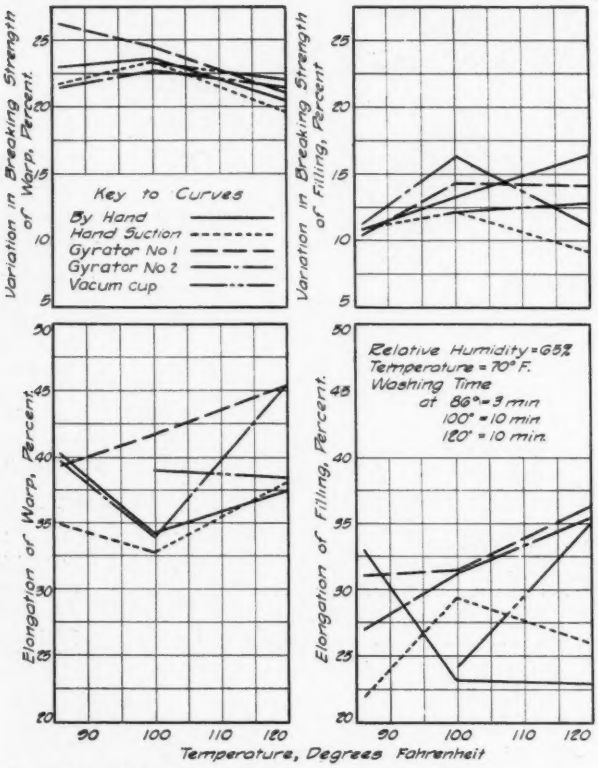


Fig. 5. Effect of variation in washing temperatures upon the breaking strength of all-wool blanket fabric.

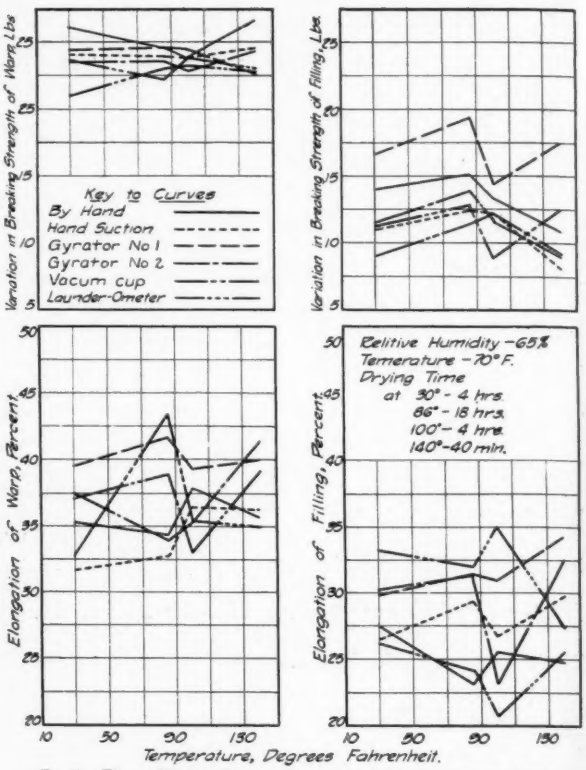


Fig 7. The effect of variation in drying temperatures on the breaking strength of all-wool fabric.

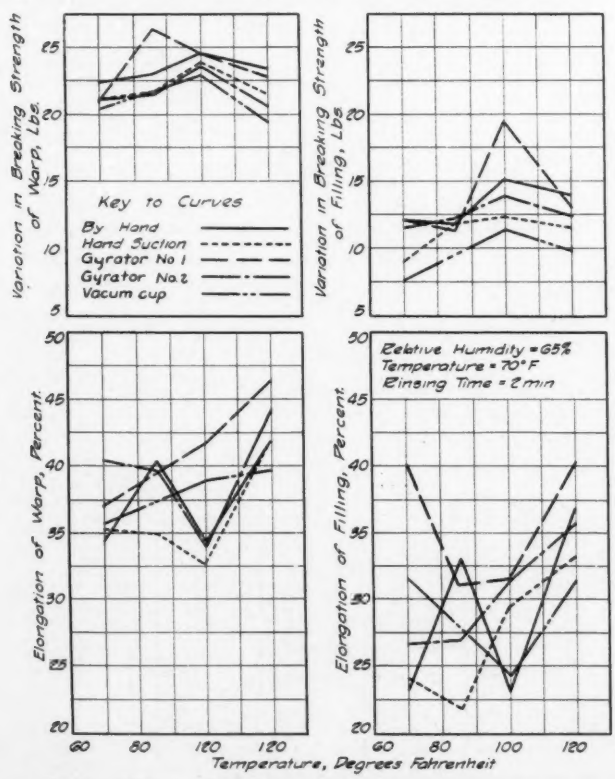


Fig. 6. Effect of variation in rinsing temperatures upon the breaking strength of all-wool blanket fabric.

Discussion of Plate I.

Plate I, section 1, shows the loosely constructed twill weave blanket fabric, as it comes from the loom, as being made up of warp yarns of the same size and twist and of filling yarns in two different sizes and twists, with many loose ends of the fibers exposed.

Plate I, section 2, shows the blanket fabric after being washed in the mill. The yarns appear to be more closely arranged in the fabric, to have greater crimp and a greater number of loose ends, thus causing the fabric to reflect less light than the fabric in the gray.

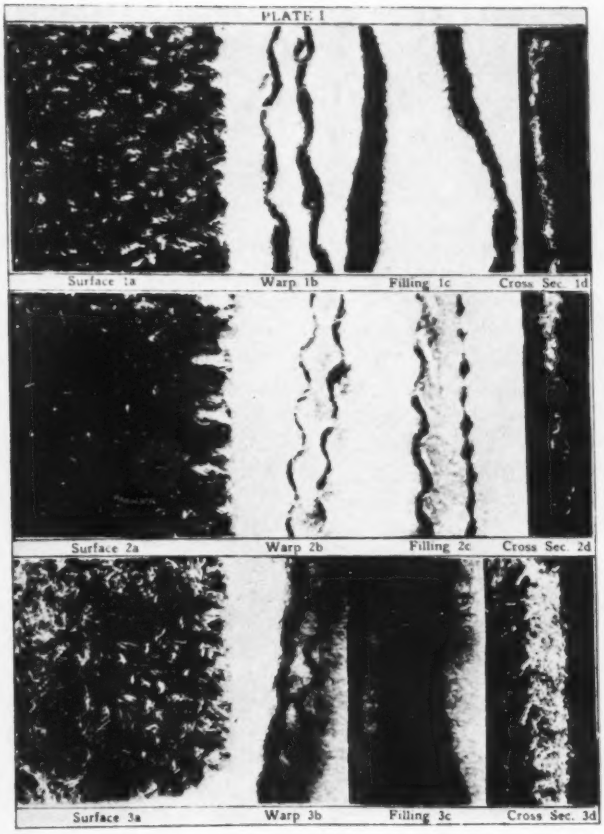
Plate I, section 3, shows the finished blanket as it is put on the market. The nap is so dense that it was necessary to cut a portion away to show the construction of the blanket. The yarns appear to be more closely arranged in the fabric than in the fabrics shown in sections 2 and 3, with little change in the warp yarns but the filling yarns were so badly torn and pulled apart as to produce sufficient nap to increase the thickness of the blanket four times its original thickness; but giving the yarns in the body of the blanket a weak appearance.

Discussion of Plate II.

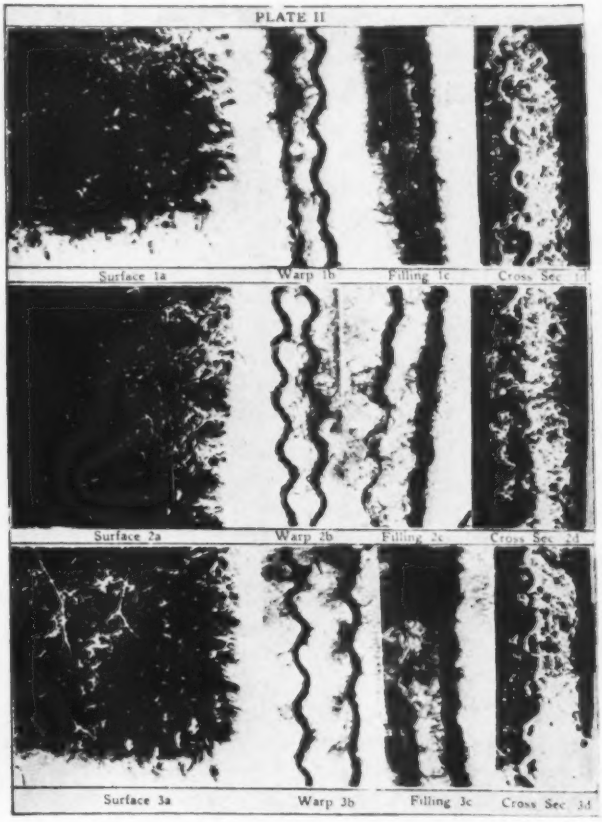
Plate II, section 1, shows the blanket specimen which was washed in the commercial laundry 3 minutes at 86° F. The fabric shows but a slight change in appearance when compared with the original blanket fabric. Plate II, section 1, when compared with Section 3, shows that the surface is less smooth with the fibers more carelessly

MICROPHOTOGRAPHS OF BLANKET FABRICS

The fabrics were magnified three times



A Comparison of the Blanket Fabric in the Gray (unwashed and unfinished) with the Washed Blanket Fabric and the Finished Blanket Fabric.



A Comparison of the Three Washed Blanket Specimens Indicating the Least Shrinkage of the Fabrics Resulting from Laundering.

arranged. The yarns have increased slightly in thickness, and the yarn crimp lessened.

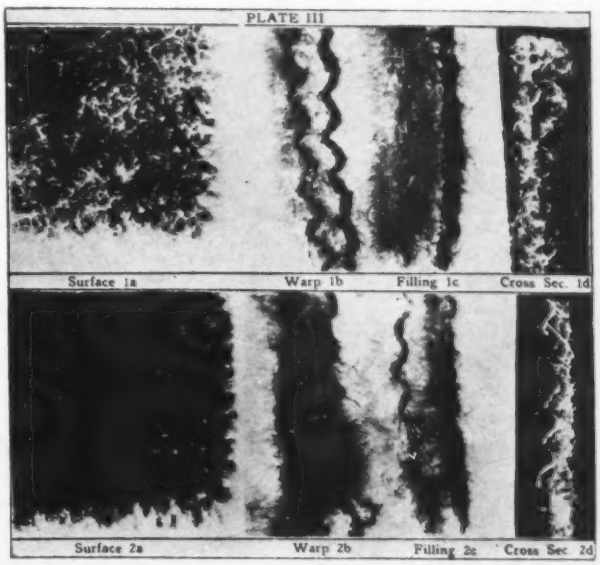
Plate II, section 2, shows the blanket specimen which was washed with the hand suction dasher 3 minutes at 86° F. The appearance of this fabric has changed but slightly. The fiber ends are more carelessly arranged than in the original specimen but less carelessly arranged than in the specimen in Section 1. The main body of the fabric shows little shrinkage with no decrease in thickness but the yarns have increased in size.

Plate II, section 3, shows the blanket specimen which was washed in the vacuum cup type of machine 10 minutes, at 100° F. and dried at room temperature. Its appearance is quite similar to the specimen shown in Section 1. There is a slight increase in the thickness of the filling yarns and an increase in yarn crimp.

Discussion of Plate III.

Plate III, section 1, shows the blanket specimen that was washed in the Number 1 gyrator type of machine, 30 minutes at 100° F. and dried at room temperature. The fibers appear to be matted, giving a very uneven surface, the warp yarns have increased in thickness, and one filling yarn is so weakened as to give the appearance of

A Comparison of the Two Washed Blanket Specimens Indicating the Greatest Shrinkage of the Fabrics Resulting from Laundering.



no yarn at all. The nap has been matted much more on one side of the yarns than on the other.

Plate III, section 2, shows the blanket specimen that was washed by hand 30 minutes at 120° F. and dried at the same temperature. The fibers on the surface appear in bunches, the weave appears very close and the thickness of the fabric has decreased to almost one-half of the original thickness. The crimp of the yarn is very pronounced in both warp and filling.

Note: Breaking strength and elongation could not be determined for the fabrics washed for 30 minutes at 120° F. because the humidity room was out of order and could not be repaired in time to complete the tests.

The laundering of the groups of specimens at room temperature and for 30 minutes at 120° F. could not be run in the vacuum cup type of machine because it was removed from the laboratory before the tests could be completed.

DISCUSSION OF DATA

The breaking strength of the new blanket fabric was reduced 19.6 per cent for the warp and 80.8 per cent for the filling when the fibers were pulled out from the yarns and broken. In order to obtain the high, thick, soft, nap desirable in a blanket and to give the greatest heat retaining quality possible, the blanket had been over napped. The durability of the blanket had been sacrificed in order to obtain these qualities. The breaking strength was much lower than the minimum set as the result of previous research. This indicated that the blanket fabric was not sufficiently strong to withstand wear and laundering.

There was an increase in the breaking strength and elongation of the blanket fabric, also an increase in the thickness of the yarns due to shrinkage resulting from laundering at high temperature and with a great amount of friction.

The greatest amount of shrinkage and felting, also a harsh, compact, inelastic, dead feeling was found in the group washed at a high temperature and with a great amount of friction. The specimen washed by hand for 30 minutes at 120° F. and dried at the same temperature showed more of these undesirable qualities than the other specimens of the group.

The groups of specimens washed for a short time in the gyrator type of machine at a low temperature, also washed, rinsed and dried at the same temperature, were soft, fluffy, and elastic, with even edges and showed little indication of shrinkage.

The increased friction of the gyrator-type machine, which ran at a high speed, caused uneven shrinkage, a loss of nap, and a bunching of the fibers on the surface of the washed fabric. The group of specimens washed in this machine gave a greater range in shrinkage than the other machines used. The vacuum-cup type machine which ran more slowly and the hand-suction dasher showed the least disturbance of the nap and resulted in the least shrinkage of the fabric.

Specimens washed in the Launder-Ometer and dried at various temperatures showed even edges and similar texture. This in most cases indicated little shrinkage. This left the blanket soft and elastic but not as fluffy as the original fabric. The specimens washed by this method had little chance to be subjected to friction because they were crowded in the class jars.

The groups of specimens dried in the dryer and those dried at freezing felt less harsh than the specimens dried in the shade, on a windy day, at 88° F.

Specimens rinsed in cold water at 70° F. remained fluffy and elastic but there was a slight indication of shrinkage, which did not appear to be due entirely to the change in temperature. Specimens rinsed in hot water were more harsh than those rinsed in cold water, but this rinse did not give a decided change in the texture of the fabric when the specimens were washed with little agitation.

Specimens washed in the commercial laundry did not shrink greatly but the nap was thicker and softer on one side of the fabric than on the other.

The best results in laundering an all-wool blanket fabric at home were obtained by washing, rinsing and drying the fabric at room temperature with the washing time reduced to the minimum, three minutes, which was sufficient time to remove soil from the fabric. To reduce the washing time to a minimum a suds was used. This was made by dissolving a good neutral soap in a large amount of soft water in sufficient quantity to prevent the suds from going down during the entire washing time. The hand-suction dasher used at a low speed increased the efficiency of the process. The vacuum-cup machine also gave good results.

In all cases the blanket fabrics laundered showed less change when a small amount of friction was used in washing, rinsing and drying. High temperature alone did not cause shrinkage and felting. This, together with friction resulting from excessive washing caused the greatest amount of shrinkage.

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NEW PRODUCTS—TRADE NOTES

• GENERAL RELEASE

General Dyestuff Corp. announces release of the following new product. A circular describing same more fully is available upon request.

Indanthren Brown BRA—manufactured by General Aniline Works and offered to the trade by General Dyestuff. It is said to have excellent fastness to light, chlorine and washing and to be suitable for the production of heavy shades of brown by the pigment padding process as applied to cotton piece goods. It is recommended by the manufacturers for machine dyeing on account of its good solubility and levelling properties. Circular G-139.

• DYESTUFFS

The July, 1936, issue of *Dyestuffs,* National Aniline & Chemical Co. publication, has recently been distributed. Included in this issue are articles on Naccolene F; screen printing (concluded); dyeing of cotton and rayon to be rubberized; formulae for the production of shades for women's gloves for Fall, 1936, as shown in the advance swatches of the Textile Color Card Association and formulae for the production of shades for men and women's shoe and leather colors for Fall of 1936 as shown in the swatches; the dyeing of rayon yarn and simple tests to identify the most important textile fibers.

• CALCO RELEASES

Calco Chemical Co. announces the following additions to its line of colors.

Calconese Brown R—for the dyeing of cellulose acetate fibers. This dyestuff produces a rich reddish brown shade said to be of very good fastness to light, washing and dry cleaning.

Calconese Blue MC—for cellulose acetate fibers. It is stated that it will be found especially suitable for use in combinations to produce dark brown and wine shades. It is said to show very good fastness to light, perspiration, hot pressing, washing and dry cleaning.

Calcoloid Golden Orange 4RD Double—the latest addition to the Calco line of dispersed vat colors. This new type, like other standards in the group, is said to possess excellent dispersibility and may be used on raw stock, yarn or piece goods.

• DU PONT MUSICAL SERIES

Du Pont, sponsor of one of radio's outstanding dramatic productions, "Cavalcade of America," since last fall, is now presenting a musical series throughout the summer in its regular period over the nationwide Columbia Broadcasting System network from 8:00 to 8:30 P. M., E.D.S.T., Wednesdays.

Arthur Pryor, America's bandstand idol, and his world-famous band are being featured in the first group of programs in the summer series, "Cavalcade of America—in Music," which began July 15.

• ANNUAL SILK PARADE

The annual Silk Parade, the nationwide promotion of silks and silk merchandise which is held under the auspices of the International Silk Guild, will commence the week of September 21 through September 26.

Recognition of silk as a symbol of the quality movement in merchandising, silk as an emblem of store prestige, and silk as the standard of luxury and serviceability in fine fabrics will be the keynote of the promotion in leading stores, according to the advance advices received by the International Silk Guild.

Supplementing the national advertising and nationwide publicity program, concrete suggestions for advertising layouts and local store publicity, window and departmental displays, radio talks, selling ideas and fashion information and material for the information of sales personnel regarding the qualities and uses of silk will be made available to participating stores by the International Silk Guild.

• TAG GENERAL MANAGER

The C. J. Tagliabue Mfg. Co. has announced the promotion of A. F. Rucks to position of General Manager.

Mr. Rucks has been associated with the Tagliabue Company for over 23 years and has gained notable experience in practically every phase of the Tagliabue Company industrial instrument business. His success in full charge of the company's activities may be readily anticipated.

The company also announces the appointment of W. C. Bennett as General Sales Manager in charge of the Eastern Territories, and E. D. Wacker as General Sales Manager in charge of the Western Territories. Both Messrs. Bennett and Wacker will spend a considerable portion of their time in the field.

• NEW ONYX CATALOG

A new, 56-page, handy-size catalog describing its entire line of processing and finishing compounds, has just been published by the Onyx Oil & Chemical Co.

The products described cover bleaching, sizing, scouring, dyeing, finishing and printing, on silk, rayon, cotton, wool, hosiery, mixed fabrics and ribbons.

In addition to the products, the catalog also includes other helpful information, among which is a comprehensive article by Dr. H. H. Mosher, research director, on the subject "The Importance of Accurate pH Control."

A copy of the new catalog may be obtained free of charge by writing to the Onyx Oil & Chemical Co.

• HERCULES EXECUTIVE CHANGES

At its regular monthly meeting recently, the Board of Directors of Hercules Powder Company elected Charles A. Bigelow a vice-president and a member of the Executive Committee. At the same meeting, Mahlon George Milliken, general manager of the Cellulose Products Department, was elected a director; and William Robert Ellis, now assistant general manager of the Explosives Department, was named general manager, taking the place vacated by Mr. Bigelow.

• DEGREES AWARDED

This year the Textile School of North Carolina State College awarded degrees to two young women who had completed all the requirements for graduation in the weaving and designing curriculum. These young women, Misses Eleanor Green and Virginia Reinheimer, both Raleigh girls, are the first women to receive undergraduate textile degrees at State College. Both of them have accepted positions with the Carolina Cotton and Woolen Mills at Spray.

Miss Reinheimer is assistant designer at the Spray Woolen Mill and Miss Green is assistant in the designing department of the cotton mills.

OPEN FORUM

Rules under which this department of the REPORTER is conducted are as follows:

1. Anyone who has a technical problem on which he would like advice may submit it to the Reporter and it will be published in the first available issue.

2. Any reader who feels that he has a solution of the problem may forward his reply to us and if we feel that the reply is suitable it will be published in a succeeding issue.

3. For each such reply published the Reporter will pay a minimum of $2.

4. In case there is more than one answer to the same question, the one covering the subject in the most complete and authentic manner will be published, or if two answers are sufficiently different both will be published. If two answers are considered equally good, the one first received will be given priority.

5. The Reporter will assume no responsibility whatsoever for the accuracy of the answers submitted—it is simply offering a vehicle for the public expression of its readers' opinions.

6. Both the questioner and answerer must send in his complete name and address. When requested we will publish only the initials or other identifying insignia.

Answer

32—I am experiencing some difficulty with knitting yarns in that they are harsh after dyeing to such an extent that they do not possess the necessary spring or elasticity to permit them to knit the same width as the natural grey yarn. In other words, material knitted from the dyed yarn under apparently the same conditions, comes from the machine wider than that knit from grey yarn. It is further a fact that I find that dyed and bleached yarn spreads out in the knitting machine as compared with that which is unbleached and which has not been specially treated in any way.

How can this be overcome? Should it best be done through the use of softeners, or, through modification of the bleaching and dyeing process? Any suggestions will be appreciated.—**W. P. B.**

Answer No. 2—It is first assumed that the yarn to which you refer is cotton.

Natural cotton yarn possesses elasticity that is impaired, probably, by inordinate swelling of the fiber. This action is dependent upon the time, concentration, temperature, and nature of the liquid in question. Harshness appears to occur when the fiber has been dispossessed of its natural wax.

It is possible to reduce harshness and maintain considerable elasticity by a reduction of the alkalinity of the detergent and saponifying agent in the preboil before or during dyeing. If at present you are using soda ash for the preboil it is suggested that you reduce the amount used until satisfactory results are obtained. The writer knows that 1-2 per cent borax, with a suitable softener, preboil produces a softer and loftier product that knits exceptionally well, probably due to a decrease in alkalinity thereby removing less natural wax. It might be advisable that you preboil and dye simultaneously with a suitable reduction of alkali, if this situation is possible.

In the case of bleached yarn it is believed there is little hope of gaining the objective you wish other than the use of suitable softening agents. Due to the fact that intense swelling has occurred and practically all the natural wax has been removed excessive decrease in elasticity and a material increased harshness is noted. Another suggestion is that you knit your bleached product a tighter knit and/or decrease the head of your knitting frame.

Factors which tend toward the maintenance of maximum elasticity and softness are (within their respective limits of safety): 1. Minimum treatment with alkali, 2. minimum time and temperature in dyeing, 3. maximum removal of excess dyestuff and assistants, 4. the use of a suitable softening agent, 5. minimum efficient drying temperature.—E. F. M.

New Question

38—I would appreciate a method to either overcome or improve crocking of basic colors.—**W. P. G.**

CLASSIFIED

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

WANTED—Thoroughly experienced man in the production of sulfonated oils and textile compounds wanted immediately. Write Box No. 915, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED—Aggressive sales manager—New England division, must have experience and clientele sulfonated oils, fatty acids and special oil products for industrial trade, textile, leather and paper mills. Write Box No. 916, American Dyestuff Reporter, 440 Fourth Ave., New York.

POSITION WANTED—Chemical Engineer, 1933, 28 years old. Three years' experience in sulfonation of tallow and castor oil. Finishing of cotton piece goods; bleaching, starching, color matching, analytical work and water conditioning. Desires a position with a progressive chemical specialty plant or a finishing plant located in a city where it is possible to attend night university in order to work on M.S. degree. Write Box No. 917, American Dyestuff Reporter, 440 Fourth Avenue, New York, N. Y.

POSITION WANTED—Dyer Available. Somewhere there is a busy superintendent or the owners of a progressive dyeing plant who can use the services of a competent man to assist in or take full charge of the dyeing end of their business. He is 35, married, with excellent background, good practical and managerial experience which fully qualifies him for this connection. Write Box No. 918, American Dyestuff Reporter.